

# Electrical Contracting

APRIL 1946

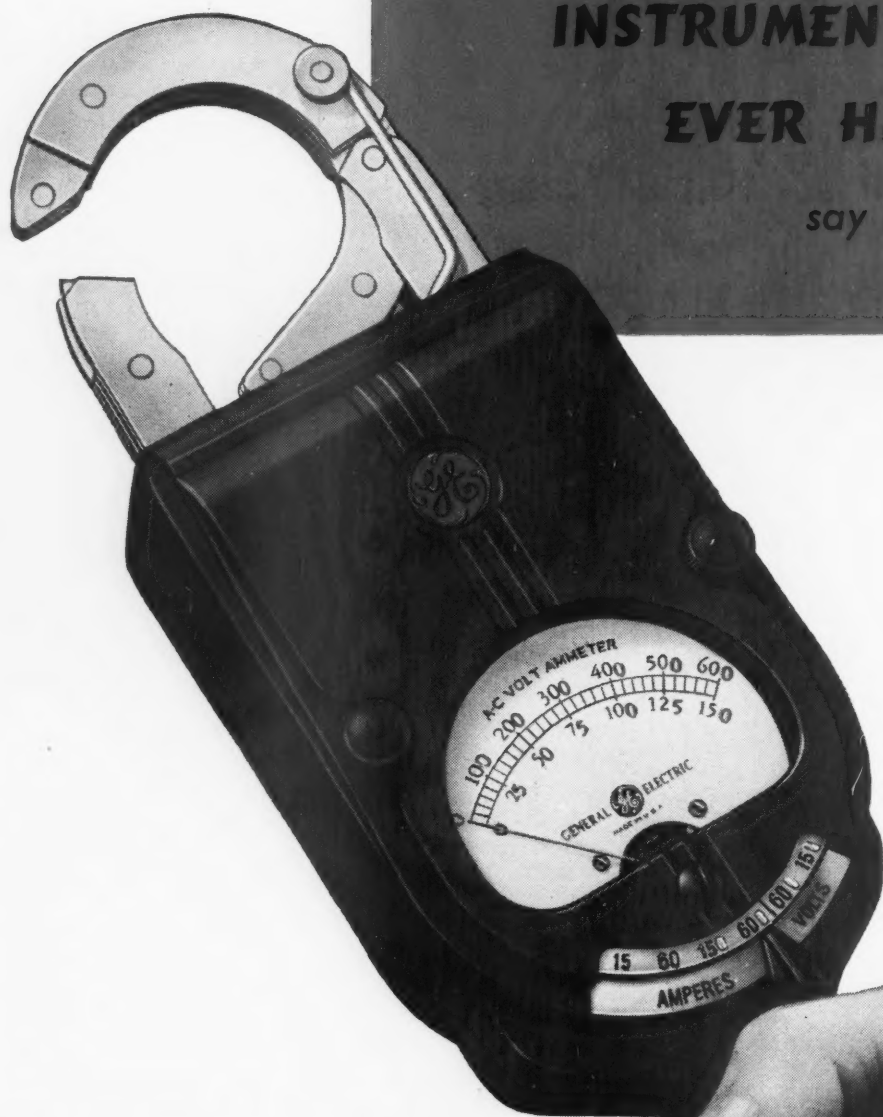
THE MAGAZINE OF ELECTRICAL  
CONSTRUCTION & MAINTENANCE



*Relight America . . . A LIGHTING SALES MANUAL FOR*  
*TODAY'S JOBS AND PROSPECTS . . . Complete In This Issue*

**"THE HANDIEST TESTING  
INSTRUMENT WE'VE  
EVER HAD"**

*say hundreds of users*



**MEASURES BOTH  
VOLTS AND  
AMPERES**  
(ACCURACY 3%)

## **G-E HOOK-ON VOLT-AMMETER**

You get double value from this handy, portable, a-c instrument. It will measure up to 600 volts and up to 600 amps. Just hook it around the conductor, push to close the gap, and read the current. Leads are provided for voltage measurements. Booklet GEA-2950 gives complete details, prices, and many helpful suggestions for operating this versatile instrument. Ask your G-E representative or write General Electric Company, Schenectady 5, New York.

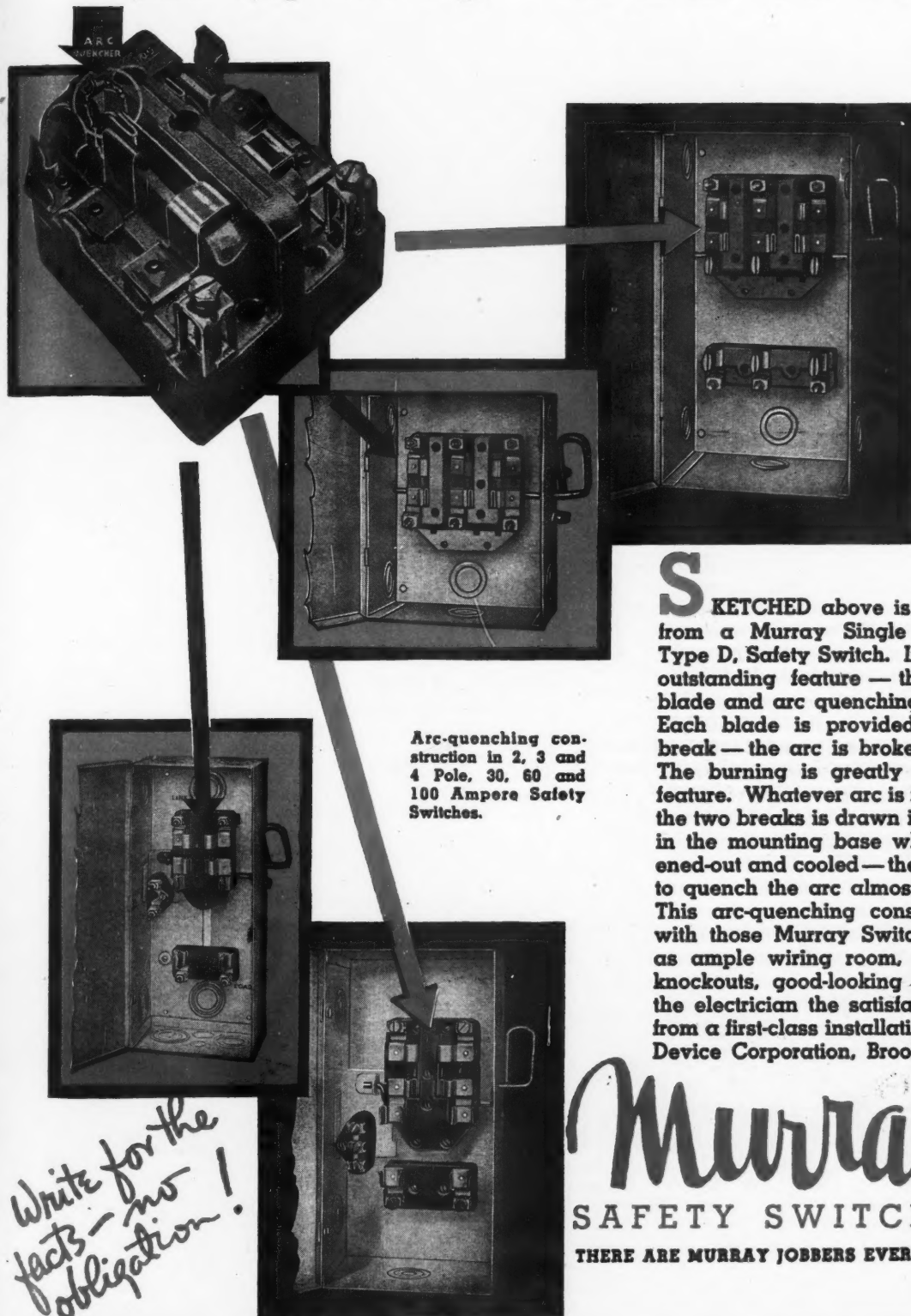
HEADQUARTERS FOR MEASUREMENT

**GENERAL  ELECTRIC**

902-94-6200



# "A FIRST CLASS INSTALLATION", *say electricians* (and they also say, "SO EASY TO PUT IN")



Arc-quenching construction in 2, 3 and 4 Pole, 30, 60 and 100 Ampere Safety Switches.

**S**KETCHED above is the switch block from a Murray Single Throw, Fusible, Type D, Safety Switch. In the circle is the outstanding feature — the double break blade and arc quenching chamber. Each blade is provided with a double break — the arc is broken into two parts. The burning is greatly reduced by this feature. Whatever arc is formed at each of the two breaks is drawn into a narrow slot in the mounting base where it is lengthened-out and cooled — the effects co-acting to quench the arc almost instantly. This arc-quenching construction coupled with those Murray Switch characteristics as ample wiring room, properly placed knockouts, good-looking cabinets, assure the electrician the satisfaction that comes from a first-class installation. Metropolitan Device Corporation, Brooklyn, New York.

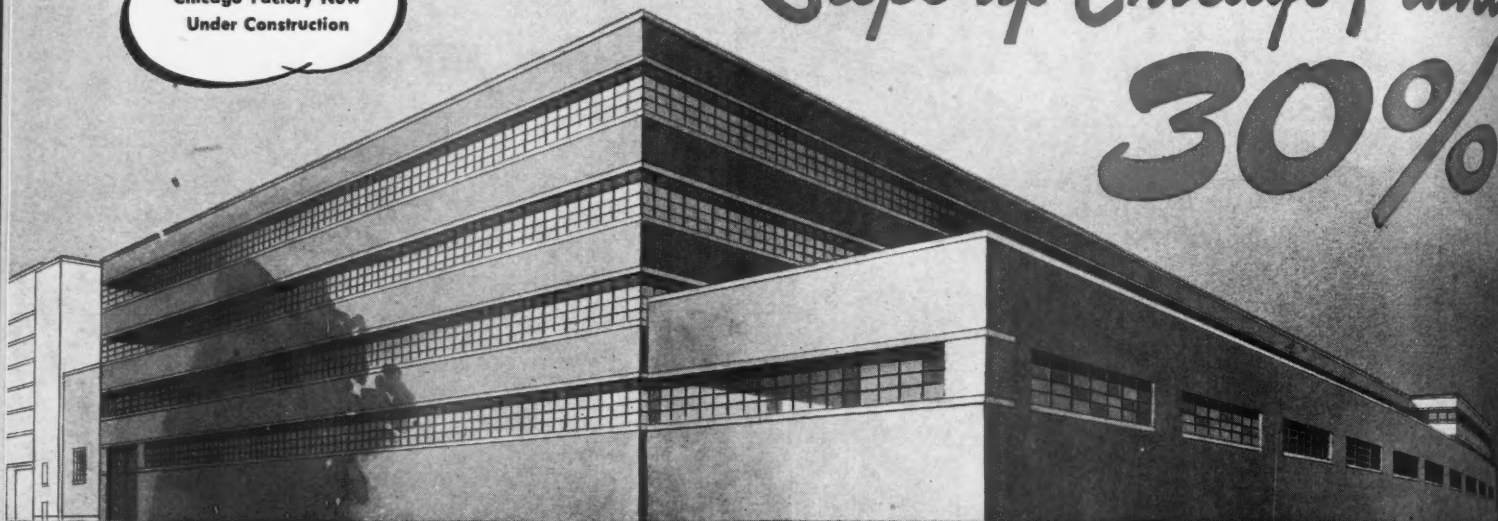
**Murray**  
SAFETY SWITCHES  
THERE ARE MURRAY JOBBERS EVERYWHERE

*Write for the  
facts — no  
obligation!*

# APPLETON BUILDS AGAIN

New unit of Appleton  
Chicago Factory Now  
Under Construction

*Steps up Chicago Plant*  
**30%**



*Huge New Unit Ready in Early Fall*

Appleton manufacturing and distributing facilities in Chicago will be stepped up substantially in the early fall with completion of still another unit of the big main Appleton plant on Wellington Avenue.

The huge new 4-story building, of reinforced concrete with face-brick exterior, has been under construction since January and will increase floor space for manufacturing facilities in the Chicago plant by approximately 30%. In addition to these facilities, Appleton operates its own malleable iron foundry devoted entirely to the production of cast malleable iron fittings sold through electrical wholesalers under the Appleton trade name.

**SEND FOR THE BIG APPLETON CATALOG**  
*Every user of electrical conduit fittings, including all your good customers, of course; should make constant use of this book, which contains full information on the complete Appleton line of over 15,000 items.*



Increased stocks of raw materials and finished goods—"Unilets," all conduit fittings, "Reelites," and other Appleton products—and vastly augmented screw-machine and other manufacturing departments will be housed in the new structure. Faster delivery schedules will result; which, it is predicted, will quickly restore Appleton service to its normal tempo and dependability.

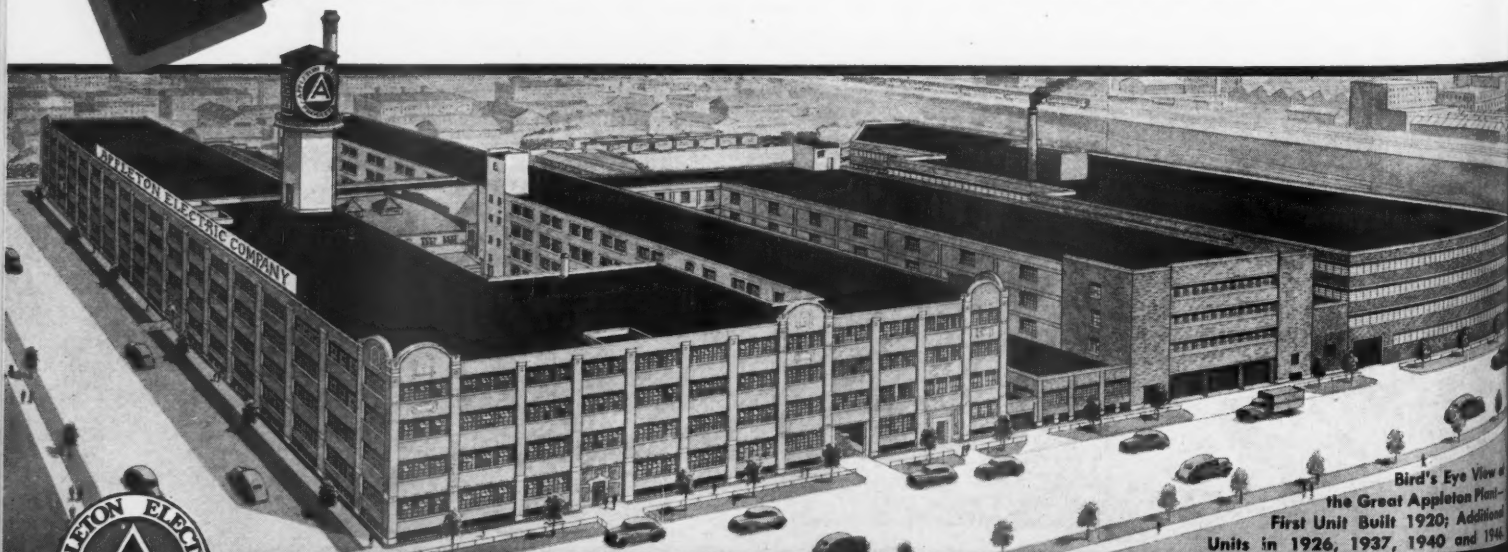
**Appleton Material Sold Through Wholesalers**

## APPLETON ELECTRIC COMPANY

1704 WELLINGTON AVENUE • CHICAGO 13, ILLINOIS

Branch Offices: NEW YORK, 76 Ninth Avenue • DETROIT, 7310 Woodward Avenue • CLEVELAND, 1836 Euclid Avenue • SAN FRANCISCO, 655 Minna Street • ST. LOUIS, 420 Frisco Bldg. • LOS ANGELES, 100 North Santa Fe Avenue • ATLANTA, 175 Luckie Street, N.W. • BIRMINGHAM, 6 N. Twenty-first Street • MINNEAPOLIS, 305 Fifth Street, S. • PITTSBURGH, 418 Bessemer Bldg. • BALTIMORE, 100 East Pleasant Street • BOSTON, 10 High Street • DENVER, 1530 Sixteenth Street • PHILADELPHIA, 1217 Race Street

Resident Representatives: Cincinnati, Dallas, Kansas City, Milwaukee, New Haven, New Orleans, Seattle.



Bird's Eye View of  
the Great Appleton Plant—  
First Unit Built 1920; Additional  
Units in 1926, 1937, 1940 and 1944

# APPLETON

CONDUIT FITTINGS • OUTLET AND SWITCH BOXES • EXPLOSION-PROOF FITTINGS • REELITES



# Electrical Contracting

With which is consolidated The Electrician and Electrical Record . . . Established 1891

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A practical technical and management journal for electrical contractors, industrial electricians, inspectors, engineers and motor shops, covering engineering, installation, repairing, maintenance and management in the field of electrical construction and maintenance.

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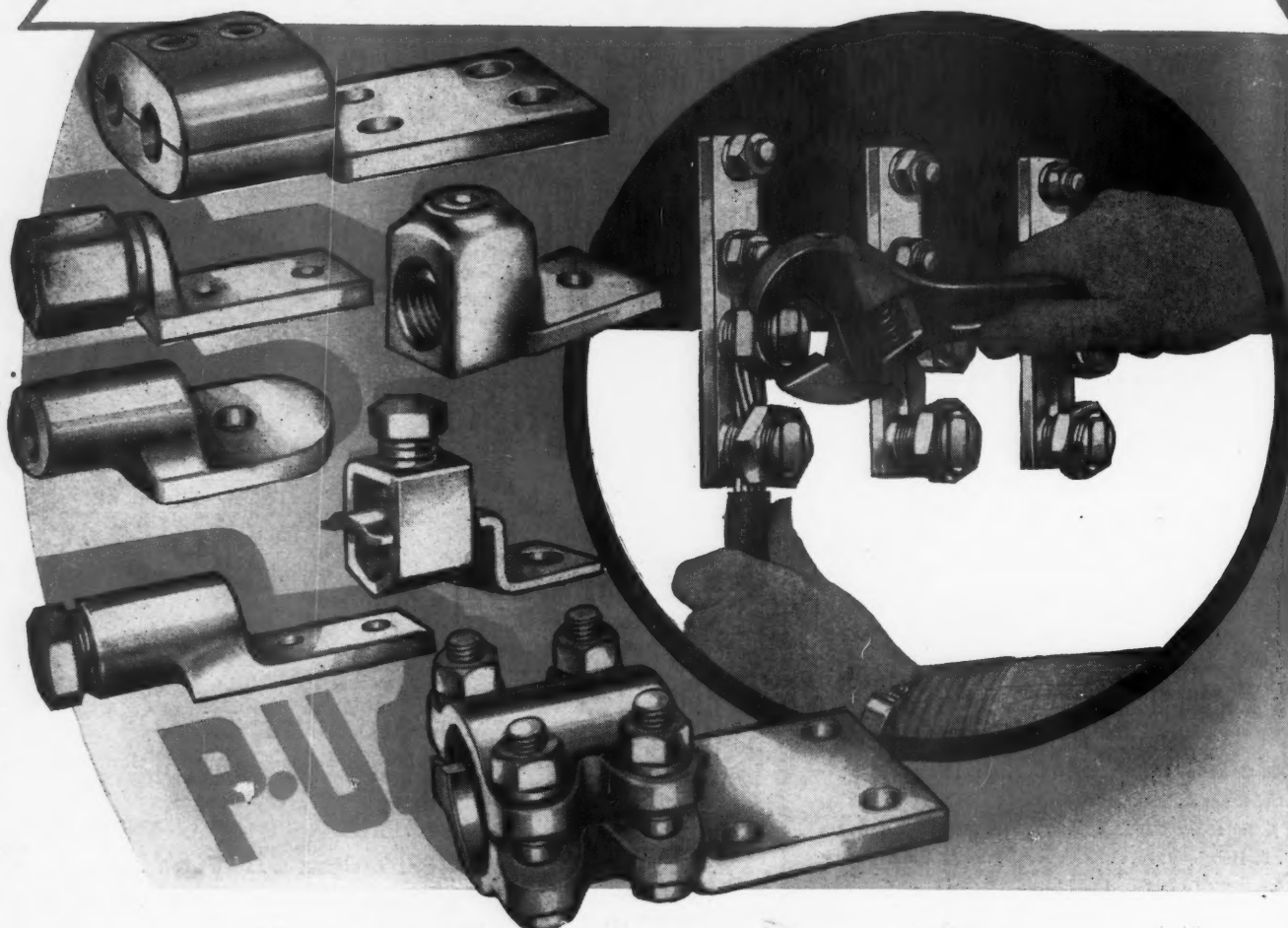
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You can pick the **EXACTLY RIGHT** lug—



• from the Complete line

You'll find that Penn-Union offers all the good types of terminals, in a complete range of sizes: Solderless lugs to grip the conductor by Bolt, Screw, Post-and-Nut, or Multi-Slit Tapered Sleeve; Vi-tite, E-Z, clamp type, shrink fit, etc., etc. Soldering lugs and sheet metal terminals in wide variety.

Also Tee Connectors; Cable Taps; Straight, Parallel, Elbow and Cross Connectors; Bus Supports, Clamps, Spacers; Grounding Clamps; Service Connectors, etc. *Penn-Union connectors are the choice of leading utilities, contractors, and manufacturers — because mechanically and electrically dependable.*

*Sold by Leading Jobbers*

**PENN-UNION ELECTRIC CORP.**

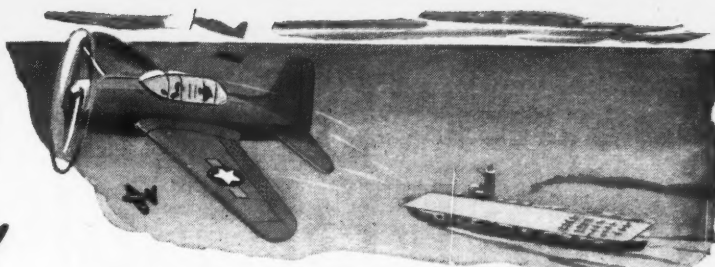
Erie, Pa.

THE Complete LINE OF CONDUCTOR FITTINGS

**PENN-UNION**



# Getting Navy Planes into Air Fast was Job for "Super" Motors!



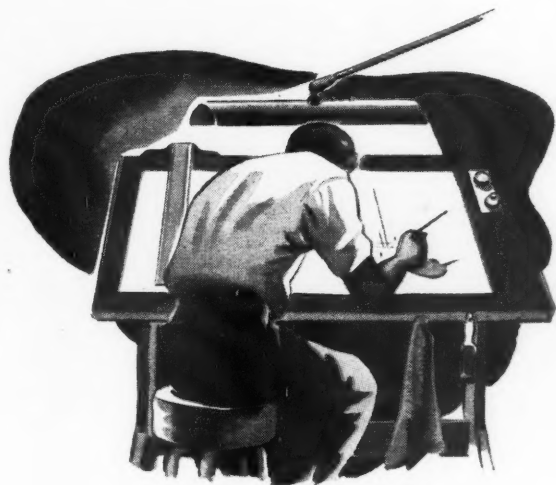
"What We Want" said Navy, "are 1/2-hour rated elevator motors that'll lift planes from carrier hangar decks, up at 42 ft, down at 52 ft a minute. And they must be exceptionally dependable—under all conditions—because these planes have to be in the air when we need 'em!"



"Look, Here's What We're Using Now. Two standard winch motors on each elevator . . . doing a good job too. But we want something better. Because *two* motors mean extra space, weight and repairs — things we've got to cut down for more important ordnance."



**Whew!** High elevator speed, low motor speed . . . stronger . . . lighter . . . smaller — this'll take 6 months to design! Then we rolled up our sleeves, tackled first the problem of developing extremely high torque for fast starting under load — solved it with a special field.



**How To Get Light Weight** — yet maintain the generous motor design for which we are famous — presented still another problem. This one we solved by skilful substitution of copper for steel . . . of war-proved fabrication for casting. Yes, we cut down weight and maintained ample, generous design!



**Came the Big Surprise!** After we put on finishing touches — special corrosion-resistant marine parts, new kind of insulation — we added up design time . . . just one month! And much-needed motors were rolling off the lines less than 4 1/2 months later.

A 1998



**Significance:** The creative engineering that goes into solving *special* motor problems, like this one, also points out new ways to build better *standard* motors for you! Watch for these new and better motors from A-C. ALLIS-CHALMERS, MILWAUKEE 1, WISCONSIN.

Wait-'til you see the NEW

ALLIS-CHALMERS MOTORS!

HEAR THE BOSTON SYMPHONY: Every Saturday Evening, American Broadcasting Co.

# CROUSE-HINDS

## Industrial Lighting Fixtures

The illustrations show a representative selection from the hundreds of different CROUSE-HINDS lighting fixtures—each designed for its own particular purpose.

**No. 3**  
of a series of advertisements which demonstrate that CROUSE-HINDS "complete line" means much more than just a range of sizes—there is a wide variety of highly specialized types in each classification.

Type C Conduit with No. 1706 Lamp Receptacle  
 Type GRF Watertight Pilot Light Conduit  
 Type FS Lighting Fixture for flush mounting in walls to light steps, floors, walks and gardens  
 Type FS Conduit with Pilot Light, Switch, and Lamp Receptacle  
 Type VR Vaportight Lighting Conduit for mounting on a hand rail  
 Type G Conduit with No. H556 Lamp Receptacle  
 Type EGP Explosion-Proof Pilot Light Conduit for panel mounting  
 Type GRF Conduit with Lamp Receptacle  
 Type GSC Conduit with Bracket Lighting Fixture  
 Type V Vaportight Lighting Conduit for mounting on machines  
 Type EFS Explosion-Proof Conduit with Double Pilot Light  
 Type GS Conduit with Shock-Absorbing Lamp Receptacle for use on machinery  
 Type LMKB Lighting Conduit  
 Type LMG Lighting Conduit  
 Type VPH Vaportight Indirect Lighting Conduit  
 Type VRC Vaportight Heavy Duty Lighting Conduit with Shatterproof Globe for use in the food industry  
 Type V Vaportight Lighting Conduit  
 Type VDA Vaportight Observation Light Conduit for mounting in vats  
 Type VXHA Vaportight Lighting Conduit with Flush Hubs  
 Type WV Vaportight Lighting Conduit with Fresnel Lens  
 Type VDS Vaportight Lighting Fixture Conduit with Dome Reflector 500-Watt  
 Type RMC Watertight Marine Lighting Fixture  
 Type MLC Watertight Marine Lighting Conduit Shock-Absorbing Receptacle  
 Type MLC Watertight Marine Lighting Conduit  
 Type DLA Dust-Tight Lighting Fixture Conduit with Flat Cone Reflector  
 Type DLA Dust-Tight Lighting Fixture Conduit 500-Watt  
 Type EVA Explosion-Proof Lighting Fixture Conduit 500 Watt  
 Type EVH Explosion Proof Hand Lamp  
 Type EVS Explosion-Proof Portable Lamp  
 Type VSI Vaportight Hand Lamp  
 Type LPH Safety Hand Lamp  
 Type EVG Explosion-Proof Lighting Conduit for gasoline pumps  
 Type RCD-8 Vaportight Lighting Fixture for wall mounting  
 Type EVA Explosion-Proof Lighting Fixture Conduit  
 Type VLG Vaportight Gauge Lighting Conduit Fluorescent  
 Type ELG Explosion-Proof Gauge Lighting Conduit Fluorescent  
 Type RCDE-8 Explosion-Proof Pit Light  
 Type VFC Vaportight Gauge Lighting Conduit  
 Type VFC Vaportight Gauge Lighting Conduit  
 Type LG Gauge Lamp  
 Type EVA Explosion-Proof Sign Light Conduit  
 Type HNS Conduit with Lighted Sign  
 Type EVA Explosion-Proof Sign Light Conduit  
 Type 2465

Complete listings of each type are in Conduit Catalog No. 2500 or in supplementary bulletins.

**CROUSE-HINDS COMPANY**  
Syracuse 1, N. Y., U.S.A.

Offices: Birmingham — Boston — Buffalo — Chicago — Cincinnati — Cleveland — Dallas — Denver — Detroit — Houston — Kansas City — Los Angeles — Milwaukee — Minneapolis — New York — Philadelphia — Pittsburgh — San Francisco — Seattle — St. Louis — Washington. Resident Product Engineers: Albany — Atlanta — Charlotte  
CROUSE-HINDS COMPANY OF CANADA, LTD., Main Office and Plant: TORONTO, ONT.

**CONDULETS · TRAFFIC SIGNALS · AIRPORT LIGHTING · FLOODLIGHTS**



QUIET HERE -



## **H**elps minds at work!

**It's the construction of G-E ballasts that helps keep fluorescent fixtures quiet.**

The distracting effects of ballast hum won't plague the employees of your customers—nor build up your complaint file—if your fixtures are equipped with G-E ballasts. Noise is *built out* of the G-E ballasts at the same time that long life is *built in*.

Constructed to exacting standards, the G-E ballast typifies G-E engineering in the various phases of fluorescent lighting. The finest low-loss core steel is uniformly rolled, stamped, and stacked as part of the *controlled quality* construction. Machine winding produces rectangular solid coils and eliminates "springy" layers, while a special sealing compound fills every void and seals the components to one another and to the ballast case.

The clamping frame is designed to prevent shifting of parts and resulting noise. Wiring is made easy by the angle slot construction which lets leads out at either ends or bottom. You can thus use one case style for many different mountings.

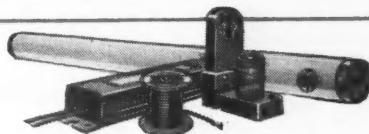
The G-E trade mark on fluorescent lighting equipment signifies the best that engineering skill and quality manufacture can produce. And remember, there is a G-E component for *every* lighting requirement. The next time you have a lighting problem, call in your local G-E representative. Our complete facilities are at your service.

Apparatus Dept., General Electric Company, Schenectady 5, N. Y.

**General Electric ballasts help keep fixture users satisfied—they mean added profits for you**

- 1 Low noise level—for satisfied users
- 2 Long life—for low maintenance cost
- 3 Characteristics matched with lamp—for rated lamp life and light output

**BALLASTS      LAMPS      STARTERS  
LAMP HOLDERS      CABLE  
for DEPENDABILITY in fluorescent lighting**



**GENERAL  ELECTRIC**

408-39-5205



## ACCENT ON FLUORESCENT

# Compco Corporation

"See the Latest in Lighting" at the International Lighting Exposition. You'll find it in Booth 78!

What's all the excitement about? FLUORESCENT—by Compco—the most merchandise-able Fluorescent line of them all! You'll see why Fluorescent's the favorite, when you see the Compco line-up. Make it a special point to see the new Compco Circline Fluorescent Fixtures and Fluorescent Lamps . . . the new Kitchen Fixtures, Bed Lamps . . . and the outstanding new commercial and industrial Fluorescent fixtures in the latest glass-enclosed and combination glass and louvre types.



General Offices and Plant:

2251 W. St. Paul Ave.

Chicago 47, Illinois

DON'T FORGET

IT'S **Booth No. 78**

THE COMPCO BOOTH!



# NO. 3

# Helpful Hints on Applying Capacitors

To help you improve power factor, reduce kva demand, increase circuit loadability and, often, reduce power costs.

## HOW CAPACITORS ARE APPLIED TO MOTORS TO IMPROVE POWER FACTOR

Improvement of power factor is often most effectively done by applying capacitors directly to the terminals of the individual motors, and switching motor and capacitor as a unit. As the "non-working" current (reactive kva) is then supplied on the spot, there is a reduction in the current flowing to the motor for any given load or overload. Therefore, it is important to make certain that there is adequate motor overload protection after the capacitors are applied.

In many cases it is necessary to change the heater units in the motor thermal relays on the basis of the reduced current of the motor-capacitor combination, as contrasted with the motor current alone.

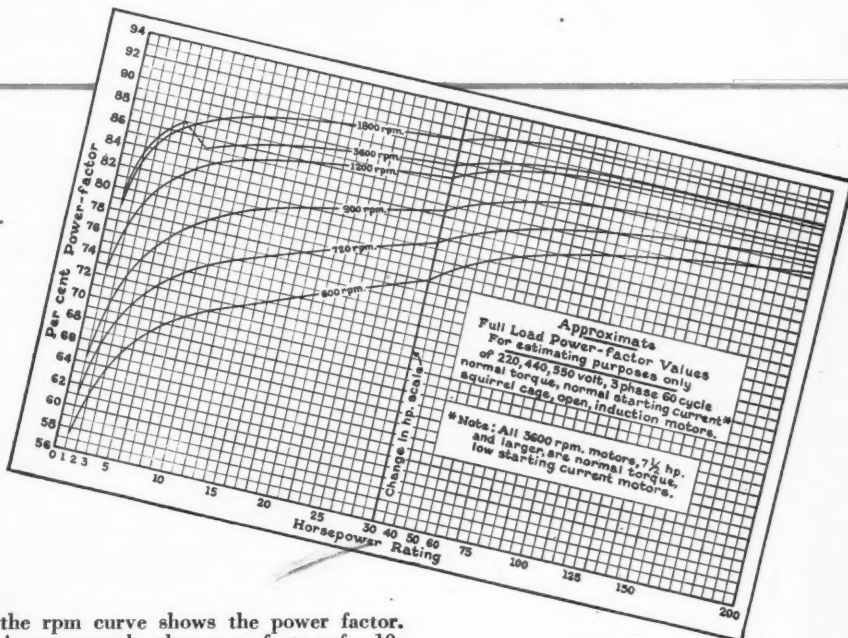
When capacitors are connected to the motor terminals directly, and are switched with the motor, it is recommended that the capacitor kva be no more than is necessary to improve the power factor to approximately 95 per cent. Excessive capacitor kva may cause overvoltage on the motor during deceleration after the switch is opened.

## SHORT CUTS TO THE RIGHT CAPACITOR KVA

In applying capacitors, it is always possible to calculate exactly the correct kvar (kilovars) if the full-load power factor, the horsepower, the efficiency, and the kw load of the motor are all known. However, the short-cut method given here is a time saver, particularly when there are a number of cases to be worked out, and gives results accurate enough for most applications.

## POWER FACTOR

The above chart gives the power factor of any squirrel-cage motor, regardless of the manufacturer, accurately enough to show the possibilities for improvement by adding capacitors. The point where the horsepower line intersects



the rpm curve shows the power factor. As an example, the power factor of a 10-hp, 1200-rpm motor is 84.5 per cent.

## CAPACITOR KVA (KILOVARS)

The table shows the standard capacitor kva ratings in kilovars recommended for use with various standard motors. For example, the 10-hp motor referred to would require a 4-kva capacitor. The table also shows, under the heading Per Cent AR, the resulting per cent reduction

in line current and is helpful in choosing the proper heater unit for thermal overload relays located on the line side of the capacitor.

Additional capacitor application data may be obtained by writing for Bulletin GEA-3225A. For product data on Pyranol capacitors to improve power factor, ask for Bulletin GEA-2742C. Apparatus Dept., General Electric Co., Schenectady 5, N.Y.

Maximum capacitor rating when capacitor and motor are switched as a unit

Induction Motor HP Rating	MOTOR SPEED IN RPM					
	3600		1800		1200	
	Kvar†	% AR††	Kvar	% AR	Kvar	% AR
10	2.5	9	4	11	4	12
15	2.5	9	5	11	5	11
20	5	9	5	10	5	11
25	5	9	7.5	10	7.5	10
30	7.5	9	10	9	10	10
40	10	9	10	9	10	10
50	12.5	9	12.5	9	12.5	9

Data for Three-phase 60-cycle Open Induction Motors of 220-, 440-, 550-, and 2300-volt Rating.

† Kvar is rated kilovolt-amperes of capacitors connected at motor terminals.

†† Per cent AR is per cent reduction in line current due to capacitors.

# GENERAL ELECTRIC

407-100-2943



A black and white photograph of a hand holding a bundle of several thin, dark wires. The hand is positioned in the upper left, with the fingers gripping the wires. The wires extend towards the right, where they are bundled together. The background is dark and indistinct.

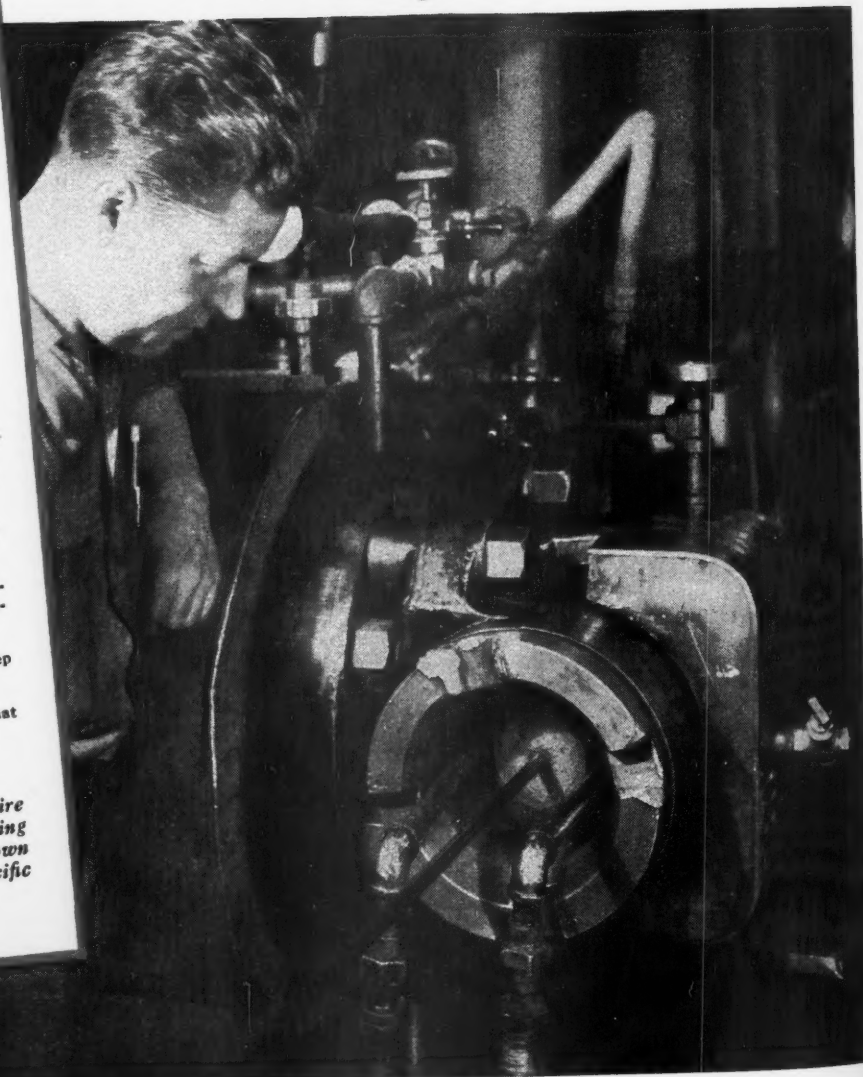
# U·S·S Ampyrol

... FOR

## CHIEF ADVANTAGES OF AMPYROL

1. **High dielectric strength**—Permits use of thinner walls for low voltage applications.
2. **Increased conduit capacity**—Larger capacity wires or a greater number of wires can be carried in a conduit of given diameter.
3. **Chemically inert**—Unaffected by moisture, acids, or alkalis.
4. **Oil resistant**—Can be immersed in oil or grease for long periods of time without damage.
5. **Ozoneresistant**—Unharmed after months of exposure to ozone that would destroy ordinary rubber insulated wires in a matter of minutes.
6. **Flameproof**—Does not burn, support combustion, or carry flame.
7. **Unaffected by sunlight.**
8. **Flexible**—Can be bent at sharp angles without damage, and is tough enough to require no protective covering for ordinary applications.
9. **Aging qualities**—Excellent due to chemical inertness.
10. **Free stripping**—Strips easily and cleanly from conductor.
11. **Easy to work**—Splices easily and is adaptable to any kind of tape. No special techniques required.
12. **Surface**—Smooth, lustrous, easy to keep clean.
13. **Colors**—Available in 12 brilliant colors that do not wear off. Makes identification easy.

Large and small U·S·S Ampyrol Wire and Cables are available. The milling and mixing of plastics is under our own control and can be varied to meet specific customer needs.





# Synthetic Resin Insulation

## LOW VOLTAGE WIRE AND CABLE



**OIL** doesn't rot it.



**WATER** doesn't penetrate it.



**CHEMICALS** don't damage it.



**FLAME** doesn't burn it.

**U-S-S AMPYROL** is a thermoplastic resin compound that is chemically inert. It is unaffected by moisture, acids, alkalis. It has withstood complete immersion in oil and naphtha for months without deterioration. Fumes from chemical plants, ash pits, steel mills, storage batteries, etc., cause no perceptible deterioration. Ozone concentrations that would destroy rubber in short order have no effect on Ampyrol.

Fire hazards are reduced, for Ampyrol neither carries flame nor supports combustion. At recommended operating temperatures, Ampyrol is flexible yet tough and wear resistant.

Greater capacity of conduits can be obtained with Ampyrol because its high dielectric strength permits thinner insulation and greater copper area. On re-wiring jobs, it is often possible to obtain enough extra capacity to avoid ripping up the old conduit system.

The applications of Ampyrol Wires and Cables are almost unlimited. For switchboards, control apparatus, motor leads, plant wiring, railway signaling, radio sets, electronic devices, house wiring, and shipboard uses, Ampyrol is distinctly superior. Write for more complete information.

### *Important Applications of U-S-S Ampyrol Wires and Cables*

1. Re-wiring industrial plants for higher capacity.
2. Railway signaling switchboards and control.
3. Machine tool wiring and motor leads.
4. Chemical or process plants, mines, steel mills.
5. Stores, offices, homes, public buildings.
6. Ships, locomotives, busses, automobiles.
7. Radio sets, electronic devices.

EVERY SUNDAY EVENING, United States Steel presents *The Theatre Guild on the Air*. American Broadcasting Company coast-to-coast network. Consult your newspaper for time and station.

## American Steel & Wire Company

*Cleveland, Chicago & New York*

*Columbia Steel Company, San Francisco, Pacific Coast Distributors*

*Tennessee Coal, Iron & Railroad Company, Birmingham, Southern Distributors*

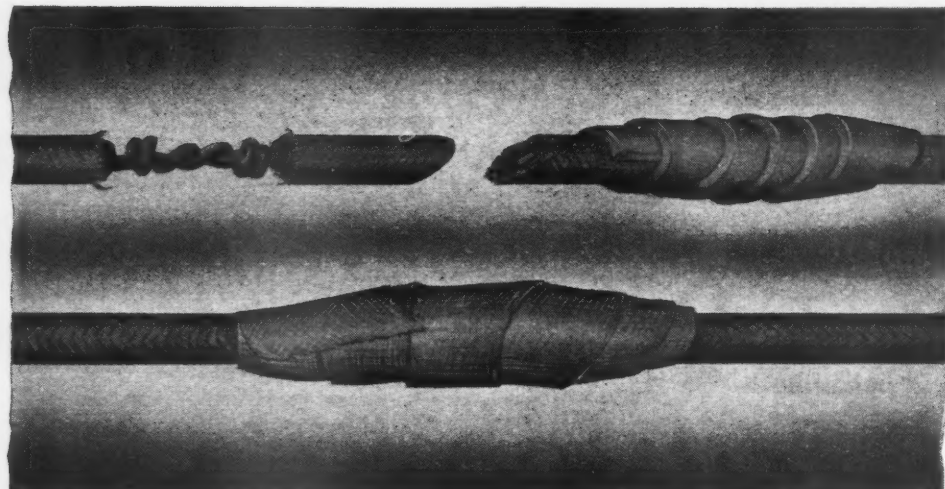
*United States Steel Export Company, New York*

**UNITED STATES STEEL**



# U-S-S Ampyrol Wire and Cable

# Long on time and service



**A magnificent painting knows no age...  
time affects it not**

So too, a running splice by a skilled electrician who uses SI Rubber tape to cover the soldered wires and then "wraps it all up" with the finest friction tape an electrician can use... Super-stik. That's the story you see before you in this ad. Why not follow the master

craftsmen... the men who know the greater adhesive and tacky properties of Super-stik... the result of a new formula... a Mintert calendar-process tape. It meets and exceeds all specifications. Ask any authorized electrical wholesaler to furnish you with a sample.

**SUPERIOR INSULATING TAPE CO., ST. LOUIS, MO., U. S. A.**

**Write for a free "test-it-yourself" splice. Mailed without charge.**

*Established 1923*



# Super-stik

## FRICITION TAPE

*"Sticks to the End"*





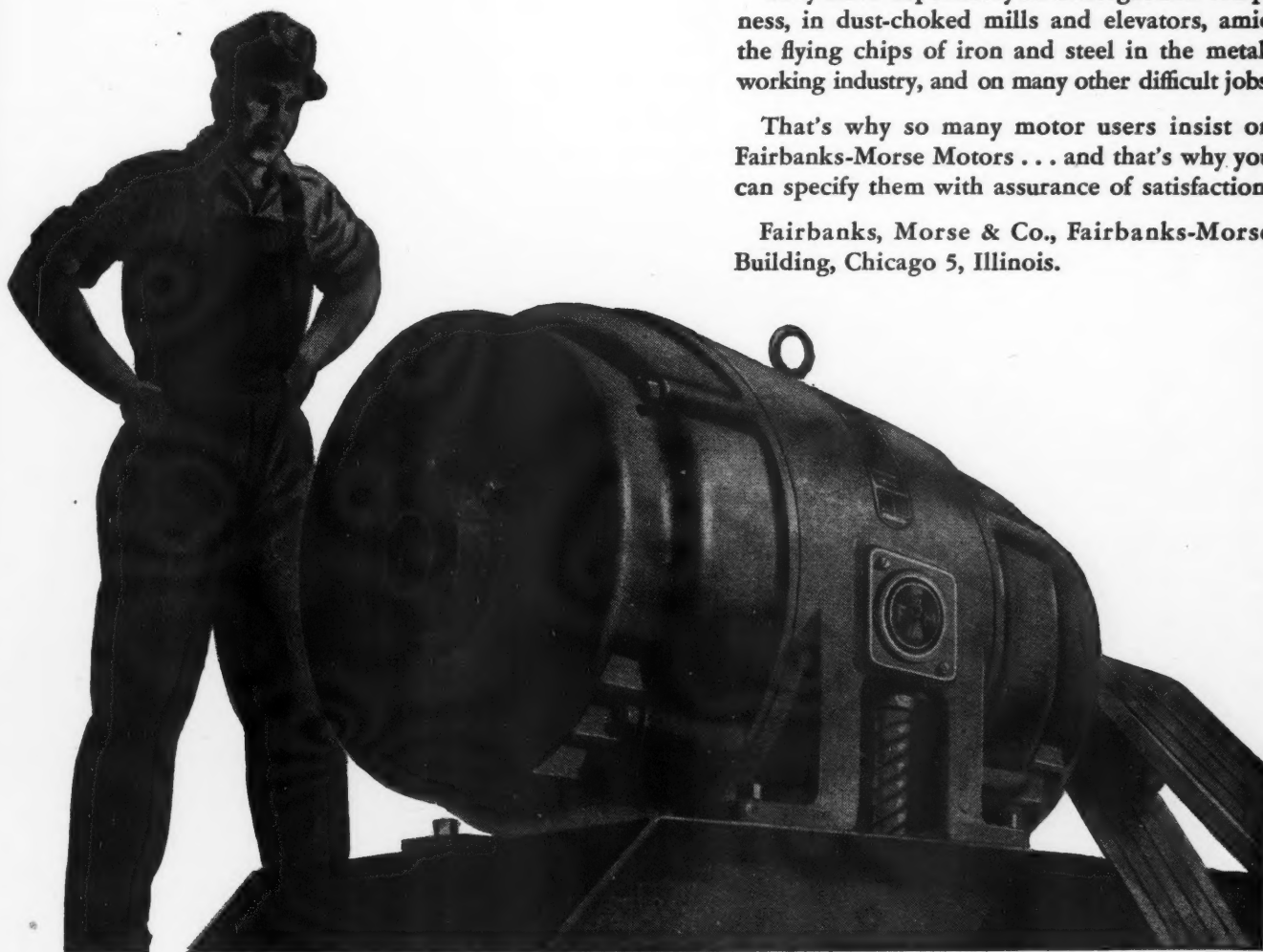
# SEE FAIRBANKS-MORSE FIRST *FOR* MOTORS

**C**ONSTANT research and development have contributed many features which make Fairbanks-Morse Motors outstanding. Today, they are an accepted standard in industry.

They serve dependably in underground dampness, in dust-choked mills and elevators, amid the flying chips of iron and steel in the metal-working industry, and on many other difficult jobs.

That's why so many motor users insist on Fairbanks-Morse Motors . . . and that's why you can specify them with assurance of satisfaction.

Fairbanks, Morse & Co., Fairbanks-Morse Building, Chicago 5, Illinois.



## Fairbanks-Morse

*A name worth remembering*



Diesel Locomotives • Diesel Engines  
Scales • Motors • Pumps • Generators  
Magnetos • Stokers • Railroad Motor  
Cars and Standpipes • Farm Equipment

FOR SAFETY'S SAKE . . . USE CONDUIT (*Full Weight Rigid Steel*)

## Planned Flexibility

THE contractors on this building were foresighted. They planned an electrical conduit system that would provide maximum flexibility for all future wiring needs—and they installed Youngstown BUCKEYE CONDUIT, as this picture shows.

For maximum flexibility in YOUR new construction jobs, or in modernization jobs replacing temporary wiring, install full-weight rigid steel conduit in such a way as to anticipate all possible future needs and changes.

Youngstown's BUCKEYE CONDUIT, installed in any building, provides a permanent, safe and easy method of increasing or varying wiring circuits at any future time. In fact, BUCKEYE CONDUIT outlasts the buildings in which it is used and gives complete protection against short circuiting or arcing from vibration, dirt, dust, moisture, or corrosion. In exposed spots its rigid, full-weight steel walls protect against crushing or other mechanical damage.

BUCKEYE CONDUIT is preferred by electrical contractors in all parts of the country for its unvarying quality and strength. It is now available through distributors in all industrial centers.



Ask your distributor for:  
Youngstown Buckeye Conduit... Pipe and  
Tubular Products... Sheets... Plates... Elec-  
trolytic Tin Plate... Coke Tin Plate... Bars...  
Rods... Wire... Nails... Tie Plates and Spikes.

# YOUNGSTOWN

THE YOUNGSTOWN SHEET AND TUBE COMPANY

YOUNGSTOWN, OHIO

Manufacturers of

CARBON - ALLOY AND YOLOY STEELS



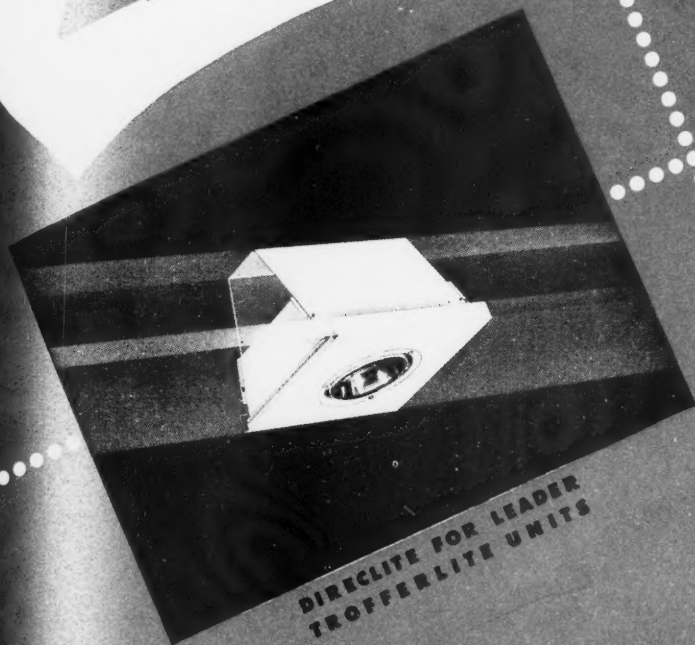




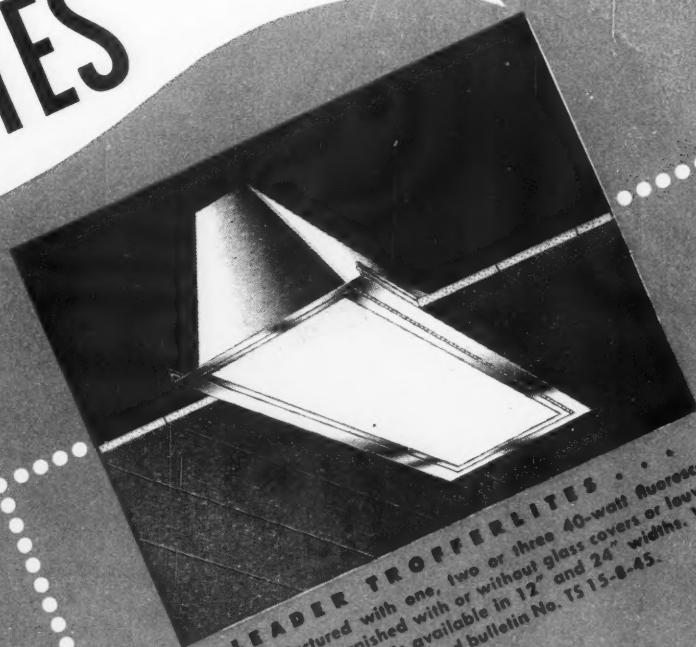
new "PLUS" for an old favorite...

a "Direclite" Feature for

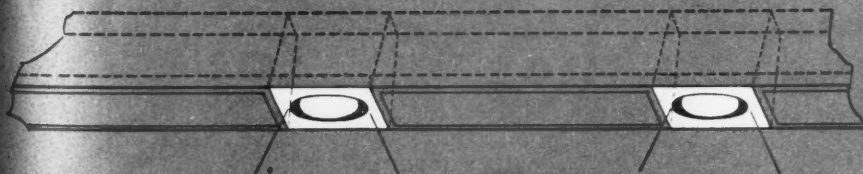
# Leader TROFFERLITES



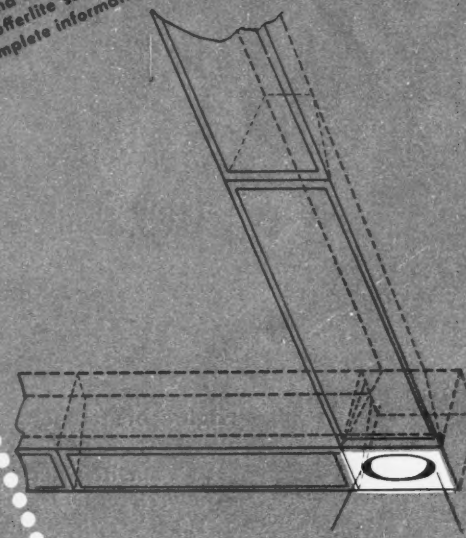
DIRECLITE FOR LEADER  
TROFFERLITE UNITS



**LEADER TROFFERLITES** . . .  
are manufactured with one, two or three 40-watt fluorescent  
bulbs and are furnished with or without glass covers or levers.  
The Trofferlite series is available in 12" and 24" widths. Write  
for complete information and bulletin No. TS 15-8-45.



use Direclite in a series



use Direclite on corners

Leader recessed Troffer fluorescent lighting units are recognized as the ultimate in good lighting. Industry large and small have accepted LEADER Trofferlite units as the answer to better lighting.

Now, you can get "Direclite," the LEADER spot-light feature, in your new installation or for use with your present Trofferlites. It's a versatile

addition, for it can be used between units in a series, or on corners. It's a grand aid to merchandising—a "must" for progressive merchants.

LEADER Trofferlites, along with "Direclite," can be installed in any type of ceiling construction and to fill a variety of lighting needs.

Only Better Electrical Wholesalers can supply you with LEADER Trofferlites and LEADER "Direclite." There is a LEADER Representative in your area. May we suggest you see him today, or write.

*Leader*

**ELECTRIC MANUFACTURING CORP., 6127 N. BROADWAY, CHICAGO 40, ILL.**

WEST COAST FACTORY . . . 2040 LIVINGSTON STREET, OAKLAND 6, CALIFORNIA



# Cooler Cables in Transit Ducts mean...

## LONGER LIFE for POWER LINES

### HOW TRANSITE DUCTS REDUCE COPPER LOSSES

Savings based upon computing the difference between Transit Ducts and organic ducts in copper losses only in KWH per year — when operating conditions produce a 19 deg. F. difference in the copper temperatures of the cable:

For 1000 ft. of 500,000 CM cable

Difference in resistance — .000862 ohms  
Difference in watts with 630  
amperes in the cable — 342.2 watts

With the cable operating 365  
days a year at capacity 50%  
of the 24-hour cycle, the  
KWH savings would be — 1.2 KWH per ft.  
per year

At \$0.0075 per KWH, this means a savings of \$0.009 per year per foot of duct.

(Figures are results of tests conducted in the J-M Laboratory for a leading cable manufacturer.)



High cable temperatures increase cable costs all along the power line!

In Transit Ducts, where cables stay cooler — reduced copper losses alone represent a savings of 1.2 KWH per foot per year.

This test case is one of many conducted by Johns-Manville Research Engineers in co-operation with a leading cable manufacturer, proving that Transit Ducts keep cables cooler — dissipate I<sup>2</sup>R losses 13% faster than other ductways tested. Copper losses are reduced, insulation life is prolonged . . . and current carrying capacity increases as much as 15%.

Made of asbestos and cement, Johns-Manville Transit Ducts are strong, immune to rust and rot. They are incombustible and unaffected by electrolysis or galvanic action. A permanently smooth bore makes possible long cable pulls and easy replacements. Long, lightweight lengths can be quickly and economically installed. In addition, a full line of fittings simplifies even the most complicated installations.

For full information write for Data Book DS-410; Johns-Manville, Box 290, New York 16, N. Y.



## Johns-Manville

## TRANSITE DUCTS

CONDUIT for use without concrete  
KORDUCT for concreting in

Take a leaf from WEBSTER'S

**Efficient** (e-fish'-ent)  
Producing desired results  
easily.

Desired results are  
easily produced with  
efficient

*Smithcraft*

FLUORESCENT UNITS

#### GREATER LIGHT OUTPUT

The Smithcraft line includes a wide variety of fixtures providing every desired lighting effect. Specially designed louvers or diffusing glass panels shield glare of tubes giving cool, abundant light. Greater down-lighting efficiency is achieved through the housing which has parabolic reflector sides.

#### SMART APPEARANCE

Beautiful and decorative, they harmonize with the interiors for which they are selected. Where space saving is a factor, minimized depth of Smithcraft fixtures permits closer ceiling mounting.

#### LOW-COST INSTALLATION

Exclusive Smithcraft hangers, ceiling plates and other features cut installation hours. Completely wired, ready to hang.

#### LOW-COST MAINTENANCE

All units were designed by Smithcraft engineers with a view to providing long operating service with a minimum of cost. Parts or lamps are easily accessible for effort less servicing or replacing.

#### DURABILITY

All Smithcraft units are of rigid, die-formed, heavy steel construction—inspected and tested to assure you long and satisfactory service. Thus, Smith craftsmanship has become accepted as the top standard in the field of lighting.

*Standard*

*Horizon*

*Peerless*

*Skylite*

*Louverlite*

*Vision*

*Ureka*

*Dawn*

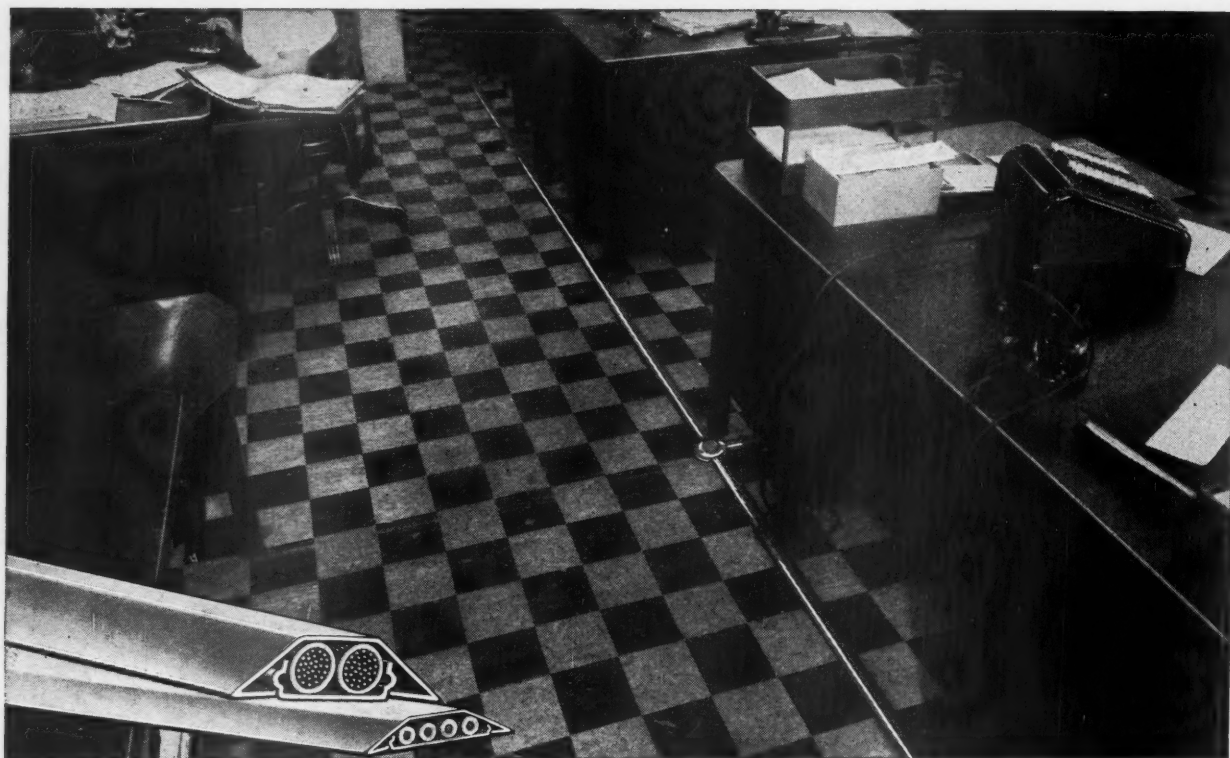
*A complete line of commercial  
and industrial fluorescent fixtures*

*Smithcraft*

LIGHTING DIVISION,

Chelsea 50, Mass.

# "Island Hopping" installations



## are jobs for **PANCAKE**

Today people with desk jobs are no strangers to machinery. They may have power driven calculating machines, bookkeeping machines, dictating machines, electric typewriters or other special equipment right on their desks . . . and all requiring electric power "delivered-on-the-job". Usually this involves an "island hopping" wiring problem . . . overfloor wiring for power and light that is best handled with PANCAKE Wiremold Overfloor Wiring Systems . . . flat as a pancake, strong as a bridge, trip-proof, with low ramp angle. With

PANCAKE and a few well designed fittings you can meet all such needs with assurance of easy extension or relocation for future changes. PANCAKE is also the approved method of connecting telephones to desks, etc., and meets all telephone company requirements. Write for bulletins and data sheets giving all details.

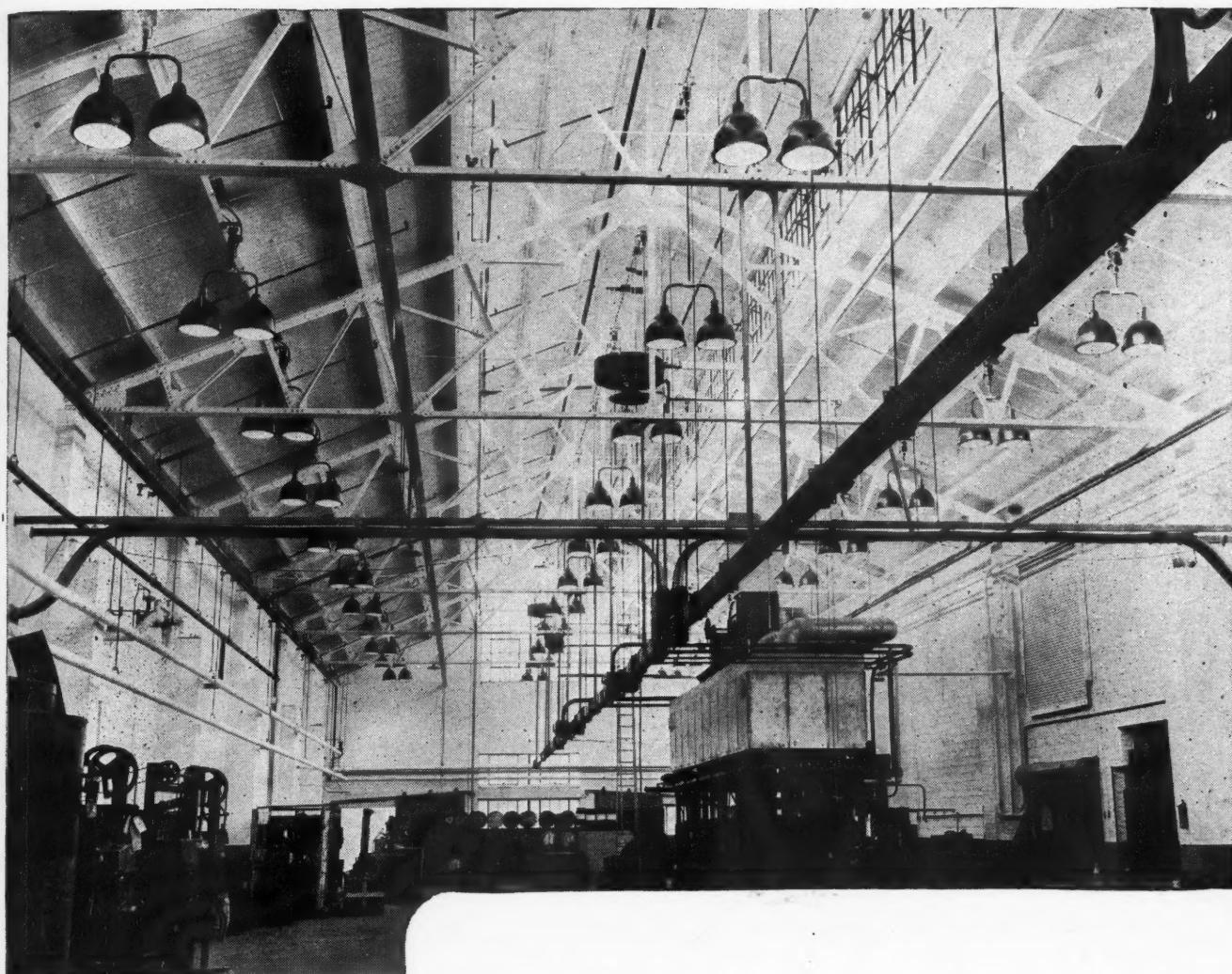
**THE WIREMOLD COMPANY**  
HARTFORD 10, CONN.



**MORE than Adequate Wiring . . .**  
from Panel Box to Outlet.

**SOLD THROUGH ELECTRICAL WHOLESALE . . . INSTALLED BY ELECTRICAL CONTRACTORS . . . EVERYWHERE!**





**DOES IT  
COST YOU  
\$2.00  
TO WASH A  
Lighting  
Fixture?**

**THOMPSON**  
DISCONNECTING & LOWERING  
**HANGERS**

● Do you know how much it costs you to clean and relamp your lighting fixtures? The few companies that have actually isolated the charge for proper cleaning at regular intervals report overall costs up to two and three dollars a fixture when the work is done from ladders, towers or cranes. This cost can be reduced 75 to 90% by using Thompson Hangers!

The Thompson Disconnecting and Lowering Hanger permits the entire fixture to be lowered to floor level for regular, thorough cleaning and relamping by your ordinary cleaning force. No skilled help is needed because the fixture is lowered electrically "dead" even though other lamps on the circuit are still lighted. No wires are lowered with the fixture.

The photograph above shows three rows of 400 watt mercury and 750 watt incandescent twin units at the Jack & Heintz plant in Cleveland, Ohio. Each unit is equipped with a new Thompson four pole—three way—four wire hanger.

It will pay you to have a Thompson engineer survey your new or relighting layout. He can help you solve your light cleaning and relamping problem.

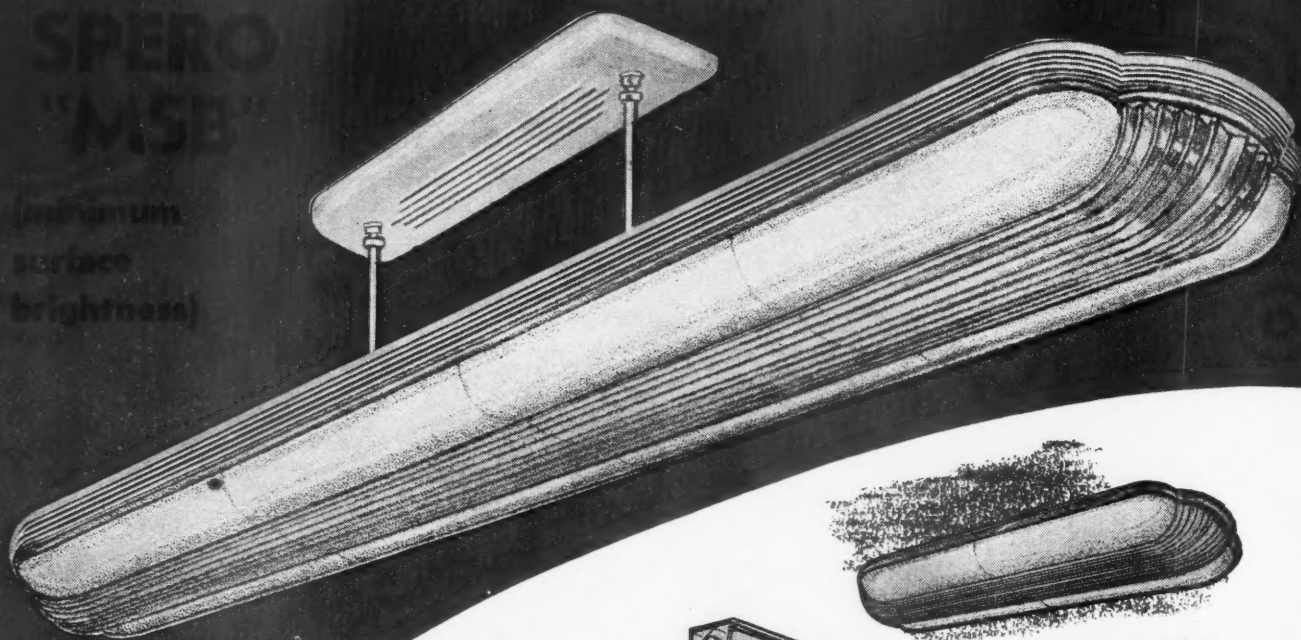
**THE THOMPSON ELECTRIC CO.**

**1101 POWER AVENUE**

**• CLEVELAND 14, OHIO**

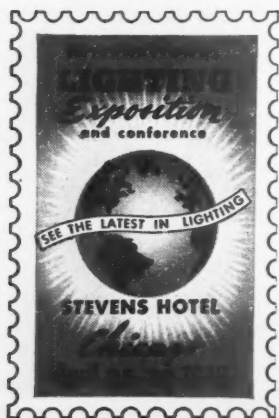
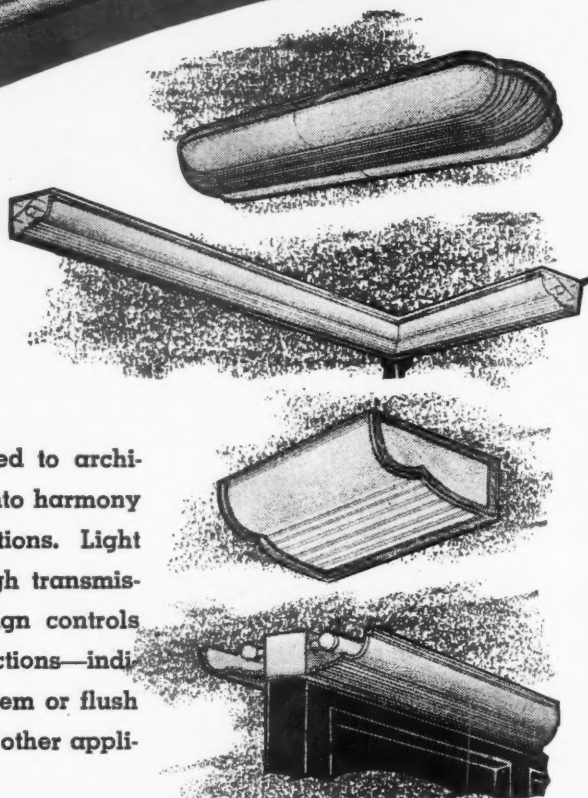
**SPERO  
"MSB"**

(minimum  
surface  
brightness)

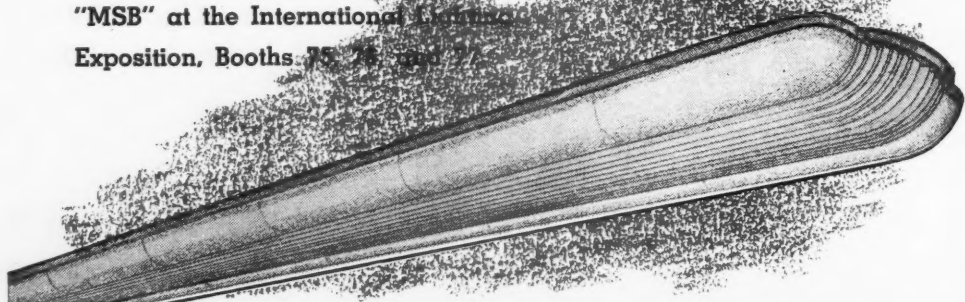


## NEW GLASS SHIELDED FLUORESCENT

Modern illuminating engineering has been applied to architectural glassware, bringing fluorescent lighting into harmony with the most smartly appointed interior decorations. Light is shielded by ceramic-finish glass, achieving high transmission with low surface brightness. Scientific design controls light in desired areas. Glass is molded in 12" sections—individual sections easily removable. Adaptable to stem or flush mounting, singly or continuous. A few of the many other applications of Spero "MSB" are illustrated at right.



See the revolutionary new Spero  
"MSB" at the International Electrical  
Exposition, Booths 75, 76 and 77.



**THE SPERO ELECTRIC CORPORATION**

18222 LANKEN AVE. ★

CLEVELAND, OHIO



# Burndy Qikluqs

For wires and  
cables with a  
*happy Ending*



Neat, compact, unit assemblies. Equipped with oversize studs to prevent stripping or distortion. Eleven sizes take 40 cable sizes. Tongues for 1, 2 or 4 holes, blank and special. Straight, 45°, 90° or right angle. Single or double clamping elements for single or multiple cables. NO SPECIAL TOOLS FOR INSTALLATION.

Catalog 41 describes all Qikline and other Burndy electrical connectors. SEND FOR YOUR COPY. Burndy Engineering Co., Inc., 107-D Bruckner Blvd., New York 54, N. Y.

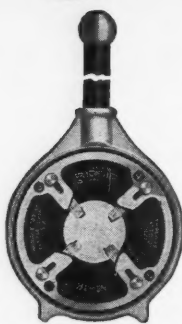
Headquarters for  
CONNECTORS  
**Burndy**



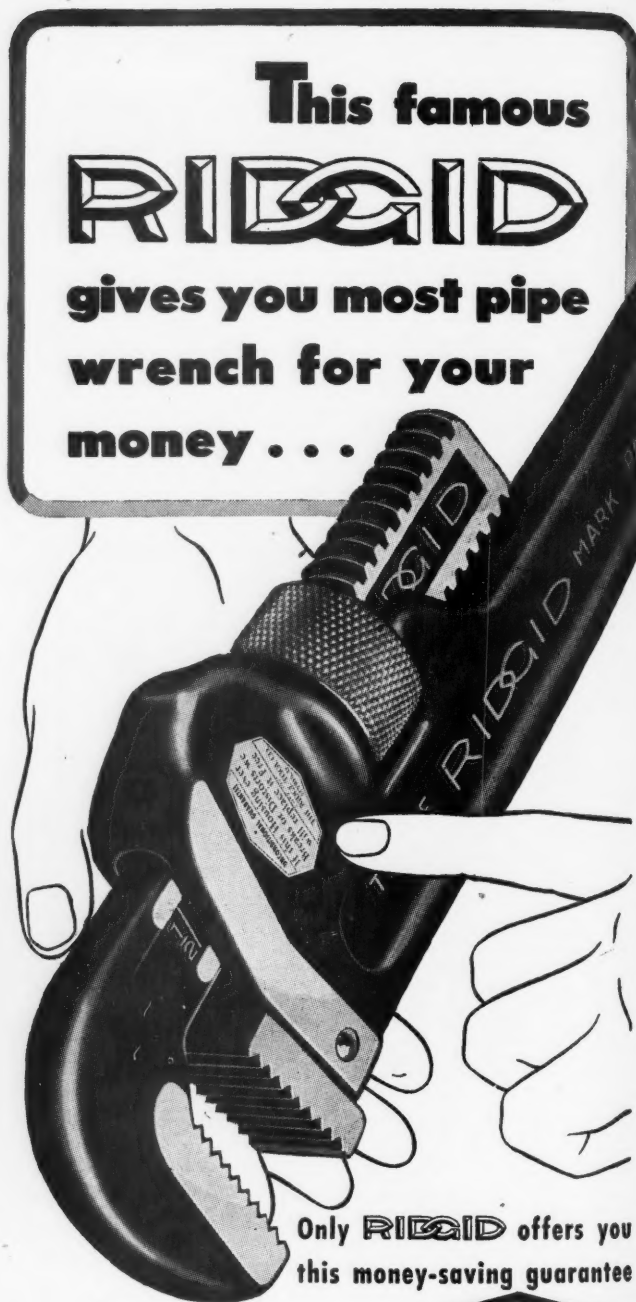


**You get perfect  
pipe threads more  
easily with this  
Self-contained Semi-automatic  
RIDGID  
No. 65R Threader**

● This modern threader is always ready to cut perfect threads on 1", 1¼", 1½" or 2" pipe. One set of chasers that stay in the die stock adjust to size in 10 seconds—work-holder sets instantly, no bushings. Precision-made in all 23 of its rugged steel-and-malleable parts, it gives you micrometer perfect threads with least possible effort—and quickly. To cut smooth threads more easily—ask your Supply House for the efficient **RIDGID** No. 65R.



*It stands up handily on the floor.*



**This famous  
RIDGID  
gives you most pipe  
wrench for your  
money . . .**

Only **RIDGID** offers you  
this money-saving guarantee



**RIDGID** End Wrench for  
pipe in coils, against flat  
surfaces.

● You get a powerful I-beam handle so comfortable you can give it all the pull you've got—*barehanded*. Precision-cut alloy jaws take-hold and let-go instantly—full-floating hook-jaw has handy pipe scale, heel-jaw is replaceable. Adjusting nut won't bind, spins freely in all sizes. And the guaranteed housing means long expense-free service—most for your money. Buy **RIDGID** at your Supply House.

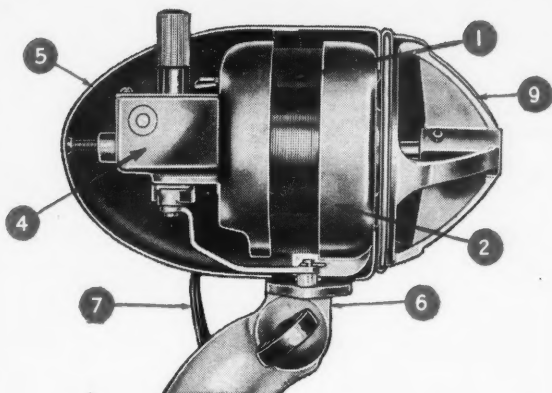
Millions of **RIDGID**  
Tools in use

**★ RIDGID ★**  
**WORK-SAVER PIPE TOOLS**

The Ridge Tool Company  
Elyria, Ohio, U. S. A.

# Original...PATENTED...FINER THAN EVER!

## SAMSON RUBBER BLADED *Safe-flex* FAN

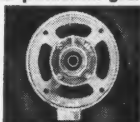


### SAMSON-BUILT MOTOR ASSURES QUIET, EFFICIENT, TROUBLE-FREE OPERATION

**1. MOTOR**—Quiet, cool-running, induction type. No brushes, commutator, or mechanical starting device. Will not interfere with radio reception. Form-wound field coils of enamel wire—taped, and entire field dipped in insulating varnish and baked. Easily replaced if damaged. 5/16" dia. steel shaft, precision-ground. Oscillating drive worm cut directly on shaft. Rotor externally ground for uniform air gap, each rotor individually balanced. 1500 R.P.M.

**2. MOTOR BEARING CASE**—Front and rear motor bearing cases die-cast, accurately machined to produce uniform air-gap and bearing alignment. Gear-case cast integrally with rear housing to insure an accurate and permanent gear alignment.

**3. BEARINGS**—Self-aligning, porous bronze bearings, with felt-packed oil reservoir. Porous construction carries lubricant to entire bearing surface.



**4. OSCILLATION**—Full 90° oscillation with finger tip control by easy-to-turn oscillation knob. Direction of air-flow may be locked in any position within oscillating range. Oscillating swivel stud screwed directly into heavy section die-cast on front motor-bearing case.

**5. MOTOR HOUSING**—Streamline motor-housing encloses and protects parts of the oscillating mechanism.

**6. HINGE**—Accurately die-cast hinge—fitted with a simple friction clamp construction. Rugged and easy to adjust by thumb screw only. Easily changed to wall mounting without special tools.

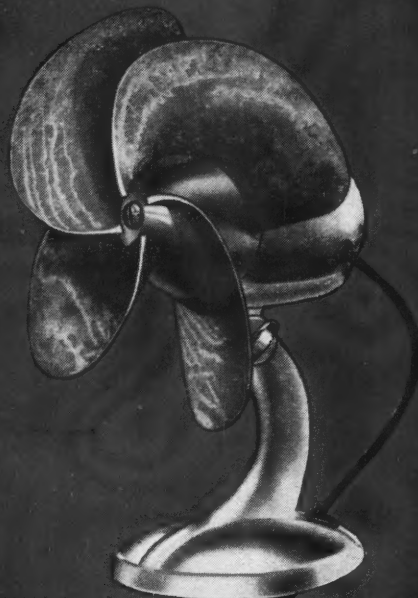
**7. CORD**—Eight-foot rubber covered cord and plug—approved by Underwriters' Laboratories.

**8. BLADE**—SAMSON safety rubber blades mounted in Steel Shell, each assembly balanced. Blade assembly, in turn, mounted on balanced die-cast spider, which locks blades in place and at the same time is cushioned from the nose-piece with rubber. Quiet operation is obtained by this construction, and by the non-resonant blade material.



**9. BLADE SPIDER**—Die-cast, machined, and balanced to insure vibration-free operation and dependable performance.

**10. WALL MOUNTING**—Simple reversible wall plate mounts fan securely to wall, eliminating vibration, and insuring safety in the wall position.



YES, THE ORIGINAL Rubber Bladed Fan . . . the famous SAMSON Safe-flex . . . is here again—finer, handsomer, quieter, more powerful than ever. As always, its patented flexible rubber blades need no shield . . . yet will not harm even a child's fingers. Improved design and construction, including the Samson-built precision-quality motor, have eliminated objectionable noises from every part that moves or can vibrate . . . assuring years of quiet, efficient, trouble-free performance. Superb new styling adds the finishing touch that makes this modern 10-inch SAMSON Safe-flex Fan the perfect breeze maker for home or office.



SAMSON UNITED CORPORATION, ROCHESTER 10, N. Y.  
Samson United of Canada, Limited, Toronto

**USE THIS NEW NON-METALLIC CABLE**

**FOR FARMS AND HOMES**

**PVX**

REGISTERED TRADE MARK

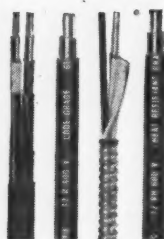
**With Thermo-plastic Insulated conductors**

**FEATURES**

1. Small overall diameter—Easy to handle. Requires smaller holes
2. Lighter weight—Facilitates handling during installation
3. Type T conductors—Insulated with long-life thermo-plastic compound
4. Small diameter of conductors—Requires less space in outlet boxes
5. Positive conductor identification—Insulation has permanent color
6. Conductor insulation—Resistant to oils, acids and alkalis
7. Insulation and braid—Both are flame- and moisture-resistant
8. Improved braid finish—Smooth, non-tacking and non-marking
9. Free stripping—Braid, paper armor and insulation all free stripping
10. High rating—Approved for 60 degree C operation

You'll like high quality PVX cable. Its small diameter and light weight make it easy to install. Its Type T conductors are insulated with thermo-plastic compound which is resistant to oils, acids, and alkalis. These conductors are protected with an improved crushed paper armor and covered with a tough moisture-resistant overall braid. The whole assembly can be freely stripped. PVX is recommended for open and concealed work in homes, farm buildings, etc., where permitted by local codes and the National Electrical Code.

**OTHER G-E BUILDING WIRES AND CABLES**



In addition to PVX there are many other wires and cables in the G-E line—wires and cables for every purpose. G-E building wires include Types T, TW, R, RH and RW in sizes No. 14 to 2,000,000 CM. G-E cables include BX armored cable, BraidX non-metallic sheathed cable and service entrance cable Type SE in all wanted sizes. These wires and cables are carefully made, uniform and have high quality.



Underwriters' Approved for  
60 degree C operation

For further information on the new PVX cable or on other G-E wires and cables see the nearest G-E Merchandise Distributor or write to Section W461-8 Appliance and Merchandise Department, General Electric Co., Bridgeport, Conn.

**GENERAL  ELECTRIC**



# Survey shows that



A recent trade survey shows that buyers consider the following features of prime importance when selecting rubber and friction tapes:

- STRONG ADHESION
- HIGH TENSILE STRENGTH
- GUARANTEED FOOTAGE
- GOOD AGING PROPERTIES
- UNIFORM QUALITY
- MAKER'S AGE AND REPUTATION
- NATIONAL DISTRIBUTION AND PROMOTION

## On all these points PANTHER and DRAGON Friction and Rubber Tapes rate high!

Made and backed by the company which has specialized for over 60 years in the insulation of electrical wires and cables, PANTHER and DRAGON Tapes are nationally distributed products.

These tapes are known for their uniform quality as well as their excellent aging characteristics. They keep in good working condition when stored on the shelf and when used in a wide range of climates. You can always be sure of the footage, too, because every length is measured.

PANTHER and DRAGON Friction Tapes adhere firmly, meet ASTM adhesion requirements. PANTHER and DRAGON Rubber Tapes fuse readily and securely, have high elongation and excellent

dielectric qualities. They pass ASTM tests for tensile strength with a wide margin of safety. All tapes pass Federal Emergency Specifications.

For further details on these tapes, or for the address of your nearest agent, write today.

## PANTHER AND DRAGON friction & rubber TAPES

Sold Through Recognized Independent Wholesalers



**HAZARD**  
**INSULATED WIRE WORKS**

Division of The Okonite Co.

Wilkes-Barre, Pennsylvania • Offices in Principal Cities 4481



# NEW USERS FOUND THAT—

## THE

# Electrunite Way



The wall thickness of Republic ELEC-TRUNITE E.M.T. (electrical metallic tubing) was not arrived at by guesswork! It was *carefully and scientifically* determined by Underwriters' Laboratories as being adequate to provide necessary mechanical and electrical protection throughout the system.

Because it is *threadless*, ELECTRUNITE E.M.T. requires no excess metal to serve as a base for thread-cutting.

## 12 Advantages

- ✓ 1. FULL PROTECTION
- 2. NO THREAD-CUTTING
- 3. INCH-MARKING
- 4. LIGHT WEIGHT
- 5. EASY TO BEND AND REBEND
- 6. STANDARD FITTINGS

- 7. EASY TO INSTALL
- 8. UNBROKEN CORROSION RESISTANCE
- 9. KNURLED INSIDE SURFACE
- 10. UNIVERSAL ACCEPTANCE
- 11. LOW COST
- 12. WIDESPREAD DISTRIBUTION

# *is The Modern Way!*

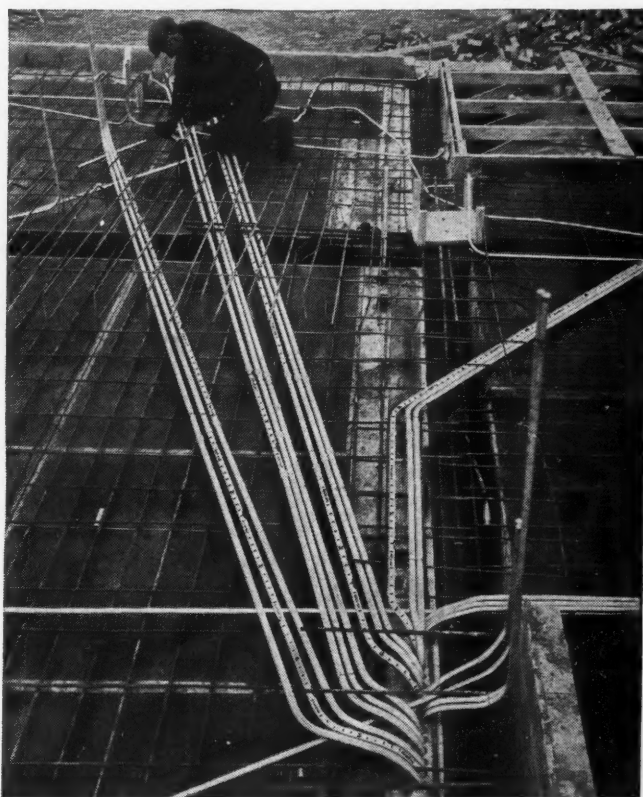
## **...When restrictions curbed the use of excess metal**

When war needs greatly restricted the amount of steel available for conduit manufacture, ELECTRUNITE E.M.T. made many new and lasting friends among its first-time users.

CONTRACTORS discovered that jobs went in easier and better when they used this *modern* rigid steel conduit. Why? Because ELECTRUNITE E.M.T. eliminates tedious thread-cutting . . . because its uniformly high ductility means easier, more accurate bending and cutting . . . because its light weight simplifies installation problems . . . because it is easy to wire . . . and because it keeps difficult work schedules moving on time.

ARCHITECTS and ENGINEERS found that ELECTRUNITE E.M.T. is readily adaptable to all types of building construction. They found, too, that it provides adequate mechanical and electrical protection . . . that its tightly-adherent zinc coating—unbroken by threads and unmarred by wrench teeth—gives continuous corrosion protection throughout every wiring installation.

Yes, there are many reasons why ELECTRUNITE E.M.T. made new friends . . . important reasons why they all agree that *The ELECTRUNITE Way is the MODERN Way.*



*No need to turn long lines when working with Republic ELECTRUNITE E. M. T. Every coupling acts as a union.*

**REPUBLIC STEEL CORPORATION**  
STEEL AND TUBES DIVISION • CLEVELAND 8, OHIO  
Export Department: Chrysler Building, New York 17, New York



*Republic*

**ELECTRUNITE E.M.T.**

REG. U. S. PAT. OFF.

**LIGHTWEIGHT THREADLESS RIGID STEEL CONDUIT**



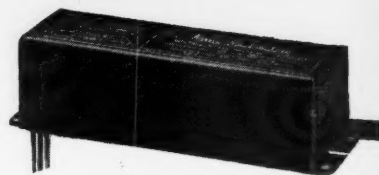


# ACME BALLASTS



**FOR BETTER  
FLUORESCENT LAMP  
PERFORMANCE**

● To provide maximum performance, for fluorescent lamps, Acme Electric ballasts were designed with electrical characteristics that meet exactly the specifications of the lamp. Equalized secondary voltage of multiple lamp type ballasts provide for synchronized starting. Important and exclusive construction features provide greater lamp brilliance, high efficiency, noise-free performance. Compare Acme Electric ballast performance.

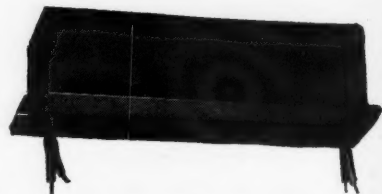


The universal mounting type ballast, with lead wires that can be arranged horizontally or vertically.



## AIR COOLED POWER TRANSFORMERS

Acme Electric, all-steel construction provides maximum physical strength with minimum weight. Acme Electric design and construction provides maximum performance . . . minimum maintenance. Built in sizes from 1/10 KVA to 75 KVA, single and three phase, all standard primaries up to 2400 volts.



Bottom lead type ballast permits economical fixture construction.

**The Acme Electric & Manufacturing Co.**  
67 Water Street Cuba, N. Y.



Acme Electric also manufactures Luminous Tube Transformers — Cold Cathode Lighting Transformers and Ballasts — Mercury Vapor Lighting Transformers — Radio and Television Transformers — Electronic Transformers — Door Bell, Chime and Signalling Transformers — Safety Transformers — Voltage Regulating Transformers — Step Down Transformers — Control Transformers — Warp-Stop Transformers — Capacitor Transformers for Power Factor Correction. **IN CANADA, Acme Electric & Manufacturing Co. of Canada Ltd.** 1434 St. Catherine St., W., Montreal 25, Que.

# IF you want to "START" something

## —use "3C" TYPE D PUSH BUTTON STATIONS



● Clark Type D Push Buttons, featuring silver-to-silver, button-type, double-break contacts, bakelite insulating parts, large electrical clearances, and plenty of wiring space, provide low maintenance and long life in heavy duty operations. Push button stop is independent of contacts. 1½" and 2¼" mushroom heads are available.

Type RN—the "ROUGHNECK"—has mushroom head, cast metal enclosure with rounded shoulders sturdy enough to take rough usage.

Watertight, dust tight, and oil-immersed types can be supplied. Pendant Stations are also available.

For every heavy duty industrial push button application there's a "3C" Push Button Station available.



### THE CLARK CONTROLLER CO.

1146 EAST 152nd ST., CLEVELAND 10, OHIO • OFFICES IN PRINCIPAL CITIES





*the Weakest Link  
must be the Safest!*



#### PROTECTION WITH ECONOMY

Wise buyers have protected their circuits and installations with ECONOMY ever since 1911. Not only has ECONOMY pioneered in fuse invention and development, but has constantly improved the quality, performance and dependability of ECONOMY Fuses and "Drop Out" Renewal Links.

Available from stock in both ferrule and knife blade types.

**OTHER TIME-TESTED ELECTRICAL FUSES**  
Arkless ... Clearsite ... Eco Midget ... Arkless Midget

SOLD THROUGH JOBBERS EXCLUSIVELY  
SINCE 1911: First to be approved by  
Underwriters Laboratories, Inc.



Time-Tested • Reliable • Safe  
REPRESENTATIVES IN ALL PRINCIPAL CITIES

1067

**ECONOMY Fuse and Mfg Co.**

2717 N. Greenview Ave., Chicago 14, Illinois

Electrical Contracting, April 1946



# SIX WAYS TO MAKE WIRING JOBS SIX WAYS BETTER!

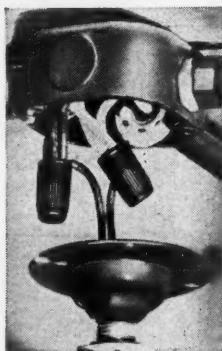


**EASIER**  
**SAFER**  
**NEATER**  
**FASTER**  
**MORE CRAFTSMANLIKE**  
**LOWER COST**

## with IDEAL WIRING DEVICES

### IDEAL "WIRE-NUTS"

Make wire joints the modern way — no solder or tape, no heat; simply strip wires, screw on, that's all! Safer wire joint! Better electrically—Stronger mechanically. Accepted as standard in wiring—new circuits, re-wiring, plant changes, re-locating machinery, etc. IDEAL'S new low prices further cut wiring costs.



**A size for every job**  
— Four sizes make all common combinations from Two No. 18 to Three No. 10 solid or stranded wires. MILLIONS IN USE. Approved by Underwriters' Laboratories, Inc.

Free Samples on Request

## PROMPT DELIVERY

- ① **IDEAL Fish Tape, Reel and Puller:** Three tools in one. Prevents tape breakage, kinking or springing around all over the floor. Makes wiring faster, better, easier. 8 sizes.
- ② **IDEAL Lugs (solder and solderless):** Made of High Quality Pressed Copper. No sharp edges or burrs. Uniform size. Approved by Underwriters' Laboratories, Inc.
- ③ **IDEAL Split Bolt Connectors:** Make permanent or temporary solderless connections. Made in bronze, brass or aluminum. Two types, "one piece" and "two piece" with either small or large heads, all sizes. **SERVICE ENTRANCE CONNECTORS** also available.
- ④ **IDEAL B-X Armor Cutter:** Snip — and the B-X cable is cut, with this handy pocket size tool. Cuts either two or three wire, No. 12 or No. 14 cable. Cuts cleanly—quickly—without injury to wire insulation. Steel cutting blade removable for sharpening.
- ⑤ **IDEAL Wire Strippers:** "E-Z" Hand Type (Stripper and cutter) a handy tool for stripping stranded and solid wire. 2 models—"Automatic" and "Standard." The IDEAL line of hand, foot and electrically operated Wire Strippers is most complete on the market.

Write for Detailed Literature

## IDEAL INDUSTRIES, Inc.

Sales offices in Principal Cities — Consult local telephone book  
In Canada: IRVING SMITH, Ltd., Montreal, Quebec



## FLUOR-O-SHIELD\* light diffuser for fluorescent lamps

### SIMPLY SNAPS ON!

- Snap-on clips permit instant attachment or removal
- Fits open-face fluorescent lamp fixtures
- For use in factory, office, store, home lighting

**FLUOR-O-SHIELD** is a simple 1-piece device readily adaptable wherever fluorescent lighting is used—as a single unit in home lighting, or as a multiple item in store, office or factory lighting. No bolts, screws or tools are required. Simply snaps on in a split second.

Wherever **FLUOR-O-SHIELDS** are used, eye-strain is reduced, with noticeable improvements in work and efficiency. Casts no shadows, will not catch dust or dirt. **FLUOR-O-SHIELDS** greatly improve appearance of all open lamp fluorescent fixtures.

**SUGGESTION TO DEALERS:** Develop a quick, money-making business through combined sales of **FLUOR-O-SHIELDS** with fluorescent lamps and starter replacements. A single demonstration will convince prospective users immediately of the many advantages of the **FLUOR-O-SHIELD** over intricate, enclosed light fixtures. Inexpensive, more practical, no installation cost.

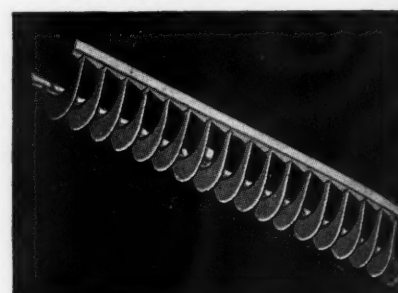
Available in two sizes: 40 and 20 watt. Order now for prompt delivery. If your distributor does not have stocks, ask him to write us.

\*Trade Mark — Patent Pending

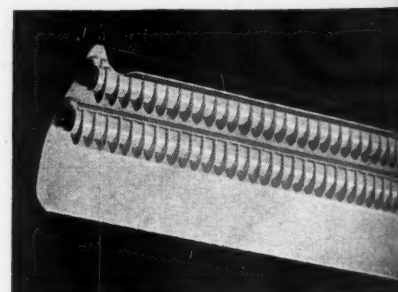
#### SPECIFICATIONS

Catalog No.	Length	Fits Lamp	Units per Pkg.
27-1-40	48-in.	40 watt	12
27-5-40	24-in.	20 watt	12

**FLUOR-O-SHIELD** by CAMFIELD MANUFACTURING COMPANY  
GRAND HAVEN, MICHIGAN



Made of durable, lightweight aluminum.  
White enamel.



No glare—greater efficiency.  
**FLUOR-O-SHIELD** casts no shadows.

**\$1.95** 40 watt  
48 inch  
Retail list price

**\$1.25** 20 watt  
24 inch  
Retail list price

*Electrical Contracting, April 1946*

**DIRECT MEASUREMENT  
OF  
*all common*  
LIGHT SOURCES**

DAYLIGHT



FLUORESCENT



NEON



SODIUM VAPOR



MERCURY VAPOR



INCANDESCENT



WESTON—Model 703 light  
Meter—calibrated in foot-  
candles and seeing tasks.

## with WESTON ILLUMINATION METERS

WESTON Illumination Meters, equipped with WESTON \*Viscor filters, insure greater accuracy in lighting measurements, and are time savers as well. They permit instant and accurate measurement of the illumination from any light source, regardless of the color composition . . . Incandescent, fluorescent, daylight, etc. . . no correction factors are necessary.

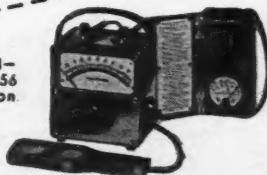
WESTON Illumination Meters, with \*Viscor filters, are available in types and ranges for all needs, from home illumination to commercial lighting and laboratory service. Send for complete information... Weston Electrical Instrument Corporation, 672 Frelinghuysen Avenue, Newark 5, New Jersey.

\*VISCOR—A copyrighted name designating the visual correction filter available only in Weston Photronic Cells and Illumination Meters.



# Instruments

WESTON—  
Model 756  
Illumination  
Meter.

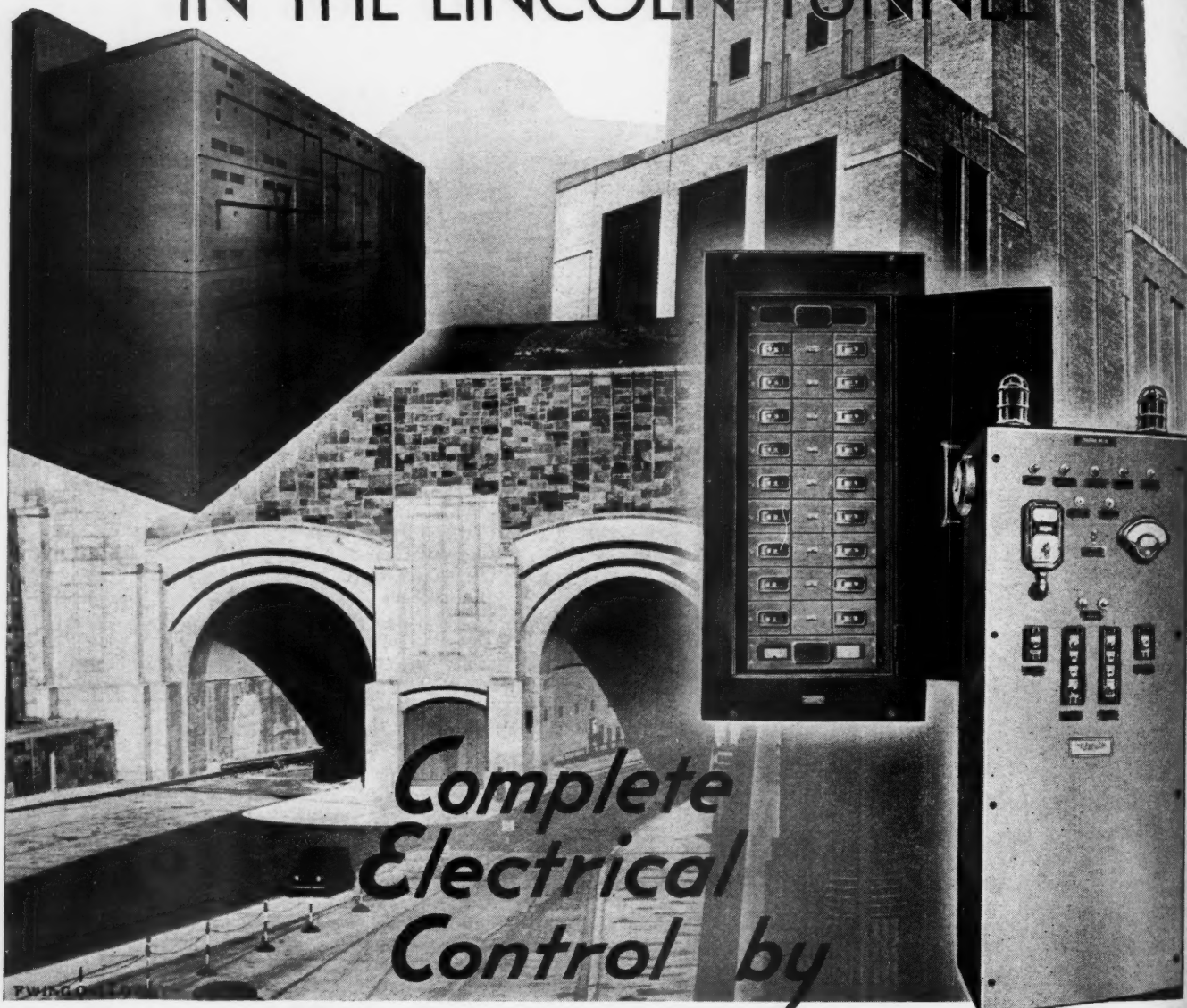


WESTON—  
Model 614  
Illumination  
Meter.

Albany • Atlanta • Boston • Buffalo • Chicago • Cincinnati • Cleveland • Dallas • Denver • Detroit • Jacksonville • Knoxville • Los Angeles • Meriden • Minneapolis • Newark • New Orleans • New York • Philadelphia • Phoenix • Pittsburgh • Rochester • San Francisco • Seattle • St. Louis • Syracuse • In Canada, Northern Electric Co., Ltd., Powerlite Devices, Ltd.



# 3 of the 18 METROPOLITAN ELECTRICAL UNITS IN THE LINCOLN TUNNEL



At the right are listed various types of electrical control equipment designed and furnished by METROPOLITAN for utilities, industrial plants, large mercantile establishments, and public buildings. Your inquiries are invited.


Knife Switchboards	Motor Control Switchboards
Circuit Breaker Switchboards	Explosion-proof Switchboards
Dead Front Switchboards	Laboratory and Test Switchboards
Battery Charging Switchboards	Control Switchboards
Generator and Distribution Switchboards	

ESTABLISHED 1892 **METROPOLITAN** TRADE MARK **ELECTRIC MANUFACTURING COMPANY**  
ELECTRIC LIGHTING AND POWER  
DISTRIBUTION EQUIPMENT  
LONG ISLAND CITY, NEW YORK



# Asbestos Insulated

## WIRES AND CABLES OF GENERAL CABLE QUALITY



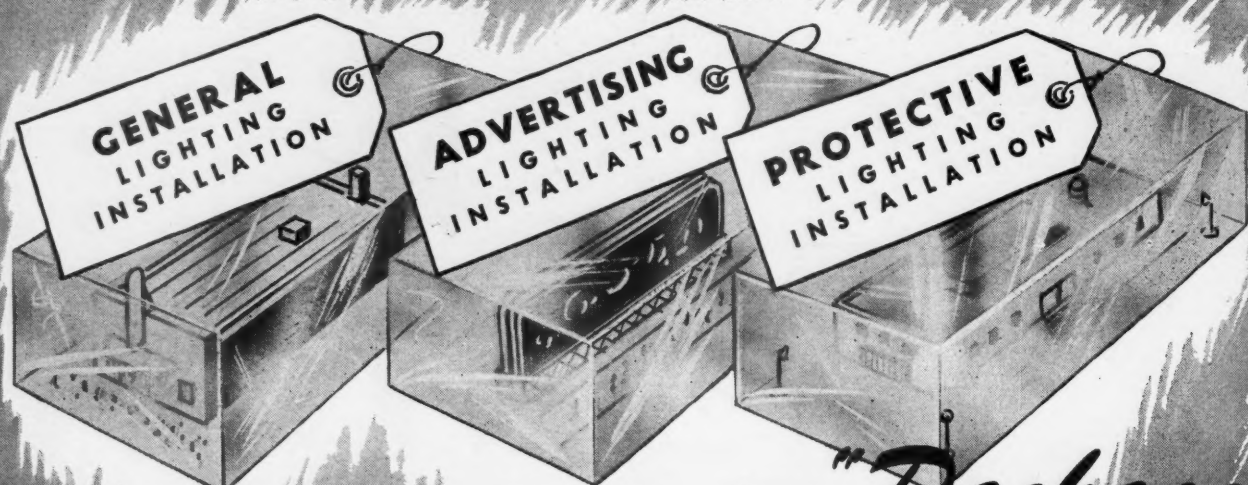
★ General Cable manufactures all sizes, all constructions in all-asbestos, and asbestos-varnished cambric for every use from power cables to instrument wiring.

Products of the same reliability which protected lives aboard the thousands of navy and merchant ships during the war. The Company's war-stimulated production capacity, with improved manufacturing techniques and experienced craftsmanship, makes General Cable your logical source of supply for all-Asbestos and Asbestos-VC Wire and Cable needs . . . Phone, write or telegraph the nearest General Cable office. Catalogs available for your advance information.

### GENERAL CABLE CORPORATION

Manufacturers of Bare and Insulated Wires and Cables for Every Electrical Purpose  
Headquarters at 420 Lexington Avenue, New York 17, N.Y. General Cable Corporation Sales Offices are located at: Atlanta, Boston, Buffalo, Chicago, Cincinnati, Cleveland, Dallas, Detroit, Houston, Kansas City, Los Angeles, New York, Philadelphia, Pittsburgh, Rome, N.Y., St. Louis, San Francisco, Seattle, Washington, D. C.





IN EVERY CASE MAKE THE "Package"  
COMPLETE BY INCLUDING

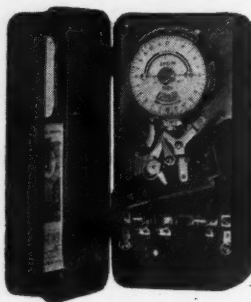


FORM KAZ—SYNCHRONOUS MOTORS  
SILVER CONTACTS

Six levers are provided for a maximum of 3 daily "on" and "off" operations. Accurate timing is obtained by turning the minute hand reset staff on the 24 hour dial. If desired the time-switch can be manually operated without affecting subsequent operations. Available in a wide variety of combinations providing two-circuits, duplex, and outdoor switches; also with Sunday and holiday omitting device, as well as advance time cutoff. The KAZ Astronomic Dial Time-Switch functions to close the circuit at sunset and open it at sunrise, or the "off" operation may be set at any time between 9:30 P.M. and 2:15 A.M.

FORM VSWZ  
SYNCHRONOUS MOTOR  
WITH CARRYOVER

Synchronous timing is combined with reserve spring clock operation, providing continuous operation during current interruptions up to ten hours. This entirely automatic carry-over eliminates the necessity of re-setting the dial after current interruptions, and insures accurate timing under all conditions. Equipped with Astronomic Dial.



**ASTRONOMIC DIAL:** Both of the Sangamo Time Switches shown here are equipped with Astronomic Dials. These dials enable "on" and "off" operations in accordance with sunset and sunrise.

# Sangamo

## TIME SWITCHES

**Y**OU'LL profit by it... your customers will benefit and profit by it.

Every time you have a "General," "Advertising," or "Protective" lighting installation, tell the customer about this **AUTOMATIC CONTROL** and its far-reaching benefits to him. You'll find each customer very receptive to your suggestions. It's the simple, modern, and dependable answer to accuracy for "on" and "off" time of each of your customer's lighting installations. No errors in timing can happen such as when dependency is placed on human fallacy.

Now is a good time to find out all about **SANGAMO TIME SWITCHES** — the business period directly ahead, with its call for new lighting installations can mean much to you in profit.

Write for a catalog today.

**SANGAMO ELECTRIC COMPANY** SPRINGFIELD ILLINOIS



# IN APRIL — SHOWERS OF PROFITS WITH HOLDENLINE CHAN'L-RUN

TRADEMARK REG. U. S. PAT. OFF. 1937

Experienced electrical contractors rely on HOLDENLINE CHAN'L-RUN to provide a shower of steady profits throughout the year. And they're profits that stay, for HOLDENLINE CHAN'L-RUN is engineered for quick and easy installation, needs practically no servicing.

Customer satisfaction is assured with HOLDENLINE CHAN'L-RUN; too, for high lighting efficiency combined with unusual durability and beauty make good lighting results certain.

## These Features Insure Profits with HOLDENLINE CHAN'L-RUN

1. High lighting efficiency—photometrically designed reflectors.
2. Lower maintenance—welded steel plate socket mountings prevent socket breakage.
3. Complete interchangeability and flexibility are provided by HOLDENline BASIC-UNIT SYSTEM. Permits fast conversion to continuous run. Has other important sales and profit advantages for you. Find out about them.
4. Ample wire freeway.
5. No dark areas between lamps on 2½" centers with CSS-80.



Ask your wholesaler for Bulletin B-45 or write to

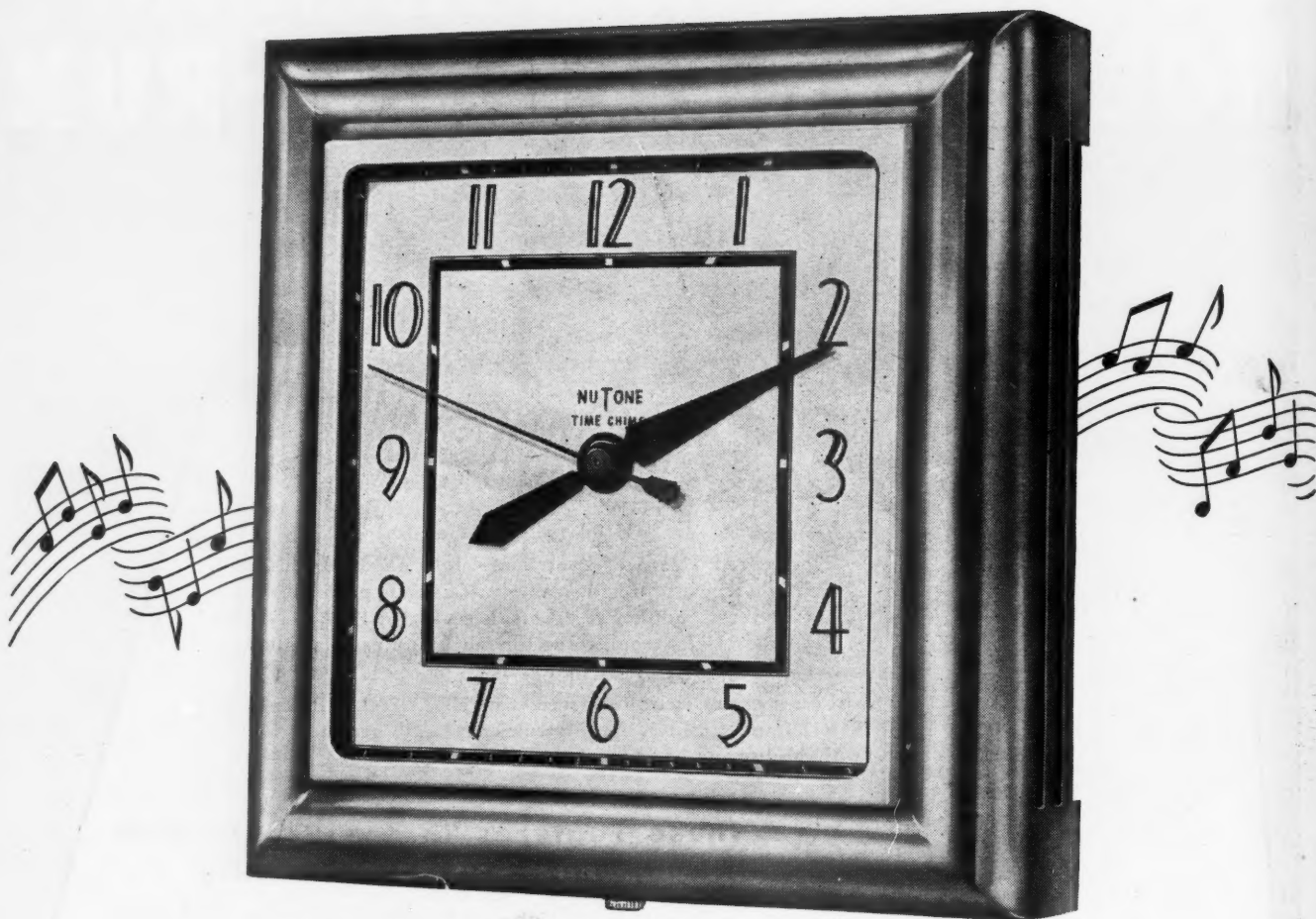
## TEN CANDLES ARE ON OUR BIRTHDAY CAKE

Ten years ago this month, before the advent of fluorescent lighting, the Holdenline Company was founded. We pioneered engineered fluorescent lighting, grew up with it, and the new Holdenline fixtures, almost ready for release, are worthy additions to a reliable, profitable line.

# HOLDENLINE COMPANY

*Pioneers in Fluorescent*

1960 EAST 57TH STREET • CLEVELAND 3, OHIO



## This NuTone Time-Chime can help you two ways!



Kitchen plans for several of the larger prewar building developments were standardized on an earlier type NuTone Time-Chime. This newest model offers you even greater advantages.



### IT SAVES YOUR TIME

—simplifies wiring. ONE unit to plan for, to wire for. Nine-inch square, all-chrome cover. Large, 6 $\frac{3}{4}$ -inch legible dial.



### EASY TO INSTALL —

even easier if kitchen outlet is provided during construction, as in several large prewar building developments that employed an earlier model NuTone Time-Chime. Many leading wiring contractors recommend the NuTone Time-Chime.



**IT'S TRUE** Most anything that can be built can be sold these days. Yet some houses, some rooms, have more built-in appeal—more

“sell”—than others. It's that way with a NuTone Time-Chime in the

kitchen. A fine new *Telechron* self-starting electric clock and 2-door NuTone Chime—in one.



**WRITE TODAY**—get all the details on the clock-chime that most women want in their kitchens. The Time-Chime lists at approximately \$12.95.

Address your nearest NuTone office. NuTone, Incorporated, Merchandise Mart, Chicago 54, Ill.; 200 Fifth Ave., New York 10, N. Y., or 931 East 31st St., Los Angeles 11, Calif.

# NU TONE

TRADE MARK

## DOOR CHIMES

WORLD'S LARGEST MAKER  
OF DOOR CHIMES

*Electrical Contracting, April 1946*



# Better Light for Seeing And Sales

**JOLECO'S SLIMLINE FLUORESCENTS ARE AVAILABLE Now!**

More than 300 footcandles of illumination bring prospective buyers to store front of American Sporting Goods Company—a huge show window attracting passers-by with appealing light.

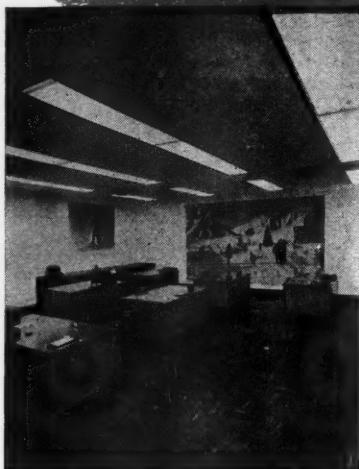
AMERICAN  
SPORTING GOODS



Here is tomorrow's lighting today—sleek and modern, geared for streamlined merchandising! Adding dramatic interest to display—offering "eye and buy" comfort for both customer and sales personnel—combining the utmost in light utilization with smart appearance—Joleco's Slimline Fluorescents are providing truly modern illumination for selling in St. Louis' most up-to-date store—American Sporting Goods Company.

Considering every factor—quantity and quality of light—adaptability to the job—modern beauty in harmony with any architectural theme—reasonable cost—economical maintenance—easy installation—plus others to meet your specific requirements—Joleco-Slimline Fluorescents offer outstanding advantages and value in light for both seeing and sales.

Learn more about Joleco's New Slimline Fluorescents and how they can help solve your lighting problems. Write today for catalog pages that will be ready soon.



Illumination in the fourth floor General Offices averages better than 50 footcandles to increase efficiency, and provide unsurpassed working comfort for employees.



The ample soft, glareless light of Joleco Slimline Fluorescents in President Harold Sieben's office help simplify the problems of directing this aggressive, ultra-modern merchandising organization.

Interiors by  
Design, Inc., St. Louis



In the first floor main selling area, Joleco Slimline Fluorescents bring more than 70 footcandles of light to the merchandise level. Above and below the mezzanine 50 footcandles is maintained. Showcase fluorescents by Joleco increase selling effectiveness.



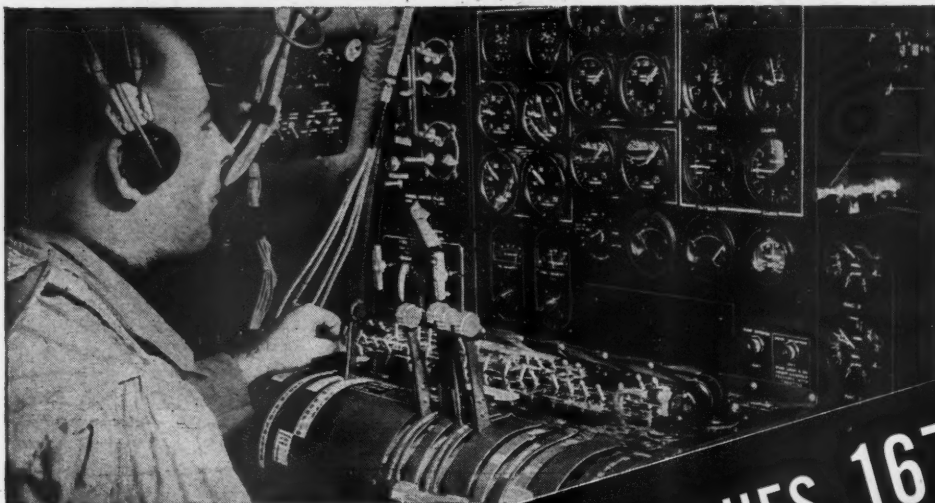
On the second floor where boats and large items are sold, surface-mounted Slimline Fluorescents maintain nearly 50 footcandles of light. In the third floor sport apparel department, sales are made under nearly 60 footcandles of light.

**JOLECO**  
CORPORATION  
Designers and Manufacturers  
FLUORESCENT LIGHTING FIXTURES

2513-18 BALDWIN ST. ST. LOUIS 6, MO.



No electrical equipment can be any better than its insulation



This varnish was chosen to meet the exacting insulation requirements on transformers for aircraft electric power . . .

# G-E INSULATING VARNISHES 1673 & 1696

Clear G-E varnishes . . . temperature resistance . . . flexibility . . .  
long life . . . for transformers of all kinds

... and the same varnish can protect a fluorescent ballast with long-lived, heat-resisting insulation.



General Electric is one of the world's largest and most experienced manufacturers of insulating varnishes. The capacity to produce millions of gallons for myriad war applications and 45 years of experience in varnish research and manufacture are now available to peace industry. Strict G-E Quality Control assures uniformity of product in every shipment of G-E Insulating Varnishes. For details consult your local General Electric Merchandise Distributor. Or write direct to Section RIMA-464, Resin and Insulation Materials Division, Chemical Department, General Electric Company, Schenectady 5, New York.



**GENERAL  ELECTRIC**

CD 46-13

G. E. OFFERS A COMPLETE LINE OF INSULATING MATERIALS

# A PACKAGE OF DAYLIGHT

## Ready to Install

Ender Fluorescent lighting fixtures offer recognized wholesalers a profitable line of modern design fixtures which give a maximum amount of light and are easily installed.

Check the advantages below of handling the Ender line.

- 1—Each unit individually packaged. No rehandling necessary.
- 2—Fixtures are interchangeable — may be used for surface or suspension mounting. Less stock required — Faster turnover.
- 3—All component parts are nationally advertised products — assuring long service—minimum maintenance.
- 4—All fixtures oven-hardened chip proof.
- 5—All fixtures approved by the National Board of Fire Underwriters.

Ender representatives will be in Booth 82 at the International Lighting Exposition with a complete new line of fixtures. Stop in and let them provide further details of why it will pay you to stock Ender fixtures.

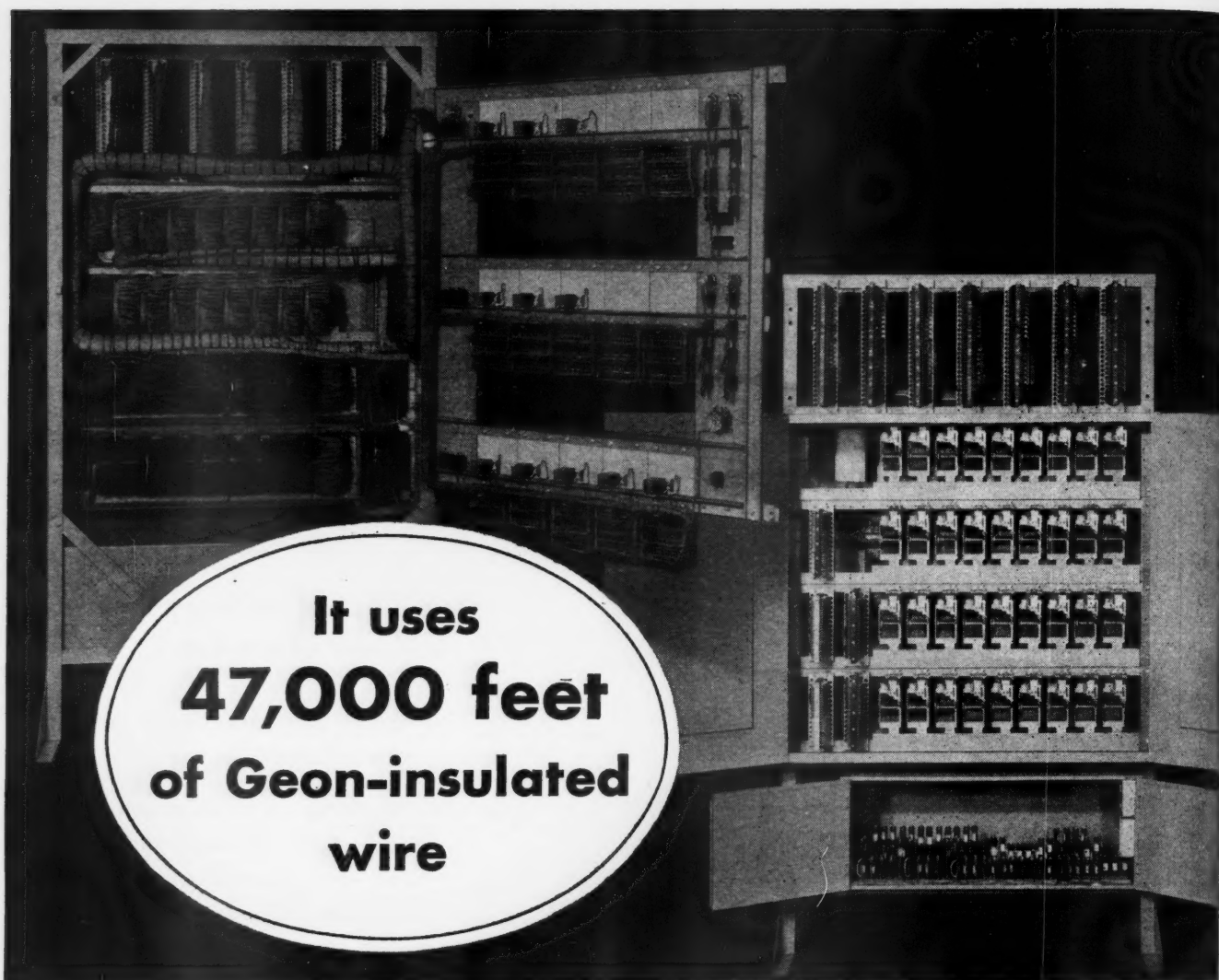


# ENDER MFG. CORPORATION

260 West Street

• 67 Vestry Street

• New York 13, N.Y.



It uses  
**47,000 feet**  
 of Geon-insulated  
 wire

## Same type insulation is revolutionizing home and industrial wiring

**T**HESE front and rear views of a Rotary Switch and Relay Bank Rack—that's what Western Union calls it—give some idea of where all the wire goes. But they don't tell why so much Geon-insulated wire is used in machines like these as well as other equally complicated instruments designed and built by Western Union engineers.

Most important, of course, are the excellent electrical properties of insulation made from GEON. They permit a thinner coating of insulation. In instrument wiring that means that the assembly engineer has more room for doing his intricate job. In building wiring it means more conductors per conduit or smaller holes to be drilled.

But insulation made from GEON offers more than this. In all types of wiring it's easier to handle because it's

smooth and non-sticky. It's easily identified because of the brilliant, permanent colors. It's highly abrasion resistant—pull it around sharp corners without fear of tearing. It resists water (GEON compounds, of course, are Underwriters approved for TW and other type wires); it resists oil and greases, acids and most other chemicals, sunlight and ozone, flexing, heat and cold, and most other normally destructive factors.

The next time you order wire—for manufacturing, home or industrial wiring—be sure to specify wire insulated with GEON now being made by leading wire and cable manufacturers. Or for more information please write Department Y-4, B. F. Goodrich Chemical Company, Rose Building, Cleveland 15, Ohio. In Canada: Kitchener, Ontario.



# B. F. Goodrich Chemical Company

A DIVISION OF  
 THE B. F. GOODRICH COMPANY

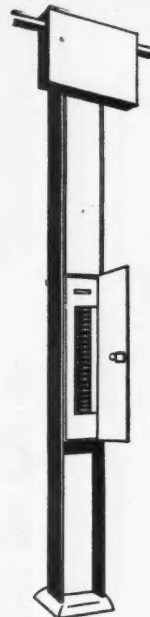


# Frank Adam

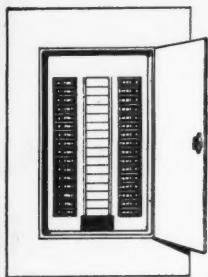
**A NAME  
KNOWN FOR QUALITY**  
for more than half a century

## PANELBOARDS

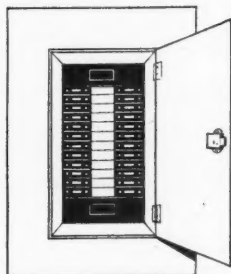
FOR OFFICES,  
FACTORIES,  
INSTITUTIONS,  
GARAGES AND  
COMMERCIAL  
BUILDINGS



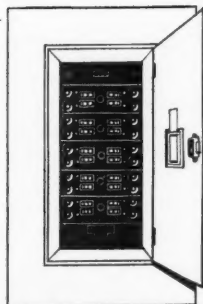
⑦ COLUMN  
Type  
Circuit Breaker



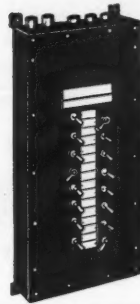
⑦ Type AC  
THERMAG  
Circuit Breaker



⑦ DUBLRAK  
Type  
Circuit Breaker



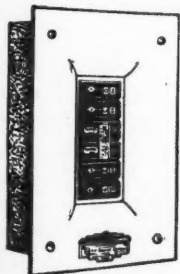
⑦ LEADER  
Type LNTIP  
Fuse and Switch



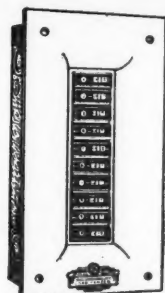
⑦ DUST-TIGHT  
Circuit Breaker for  
Lighting or Power

## LOAD CENTERS OR SERVICE EQUIPMENT

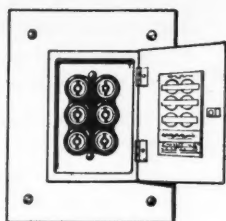
FOR HOMES  
AND OTHER  
SIMILAR SIZE  
BUILDINGS



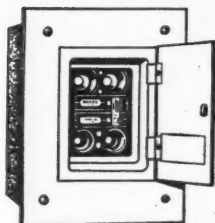
⑦ Type AC  
Circuit Breaker  
SERVICE EQUIP. with  
double pole range circuit



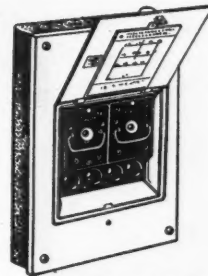
⑦ Type AC  
Circuit Breaker  
LOAD CENTER with  
all single poles



⑦ Type  
FBX  
Fuse Box



⑦ Fuse Type  
SERVICE EQUIP.  
with main switch



⑦ Switch and Fuse  
SERVICE EQUIP.  
with main switch and  
range or heater switch

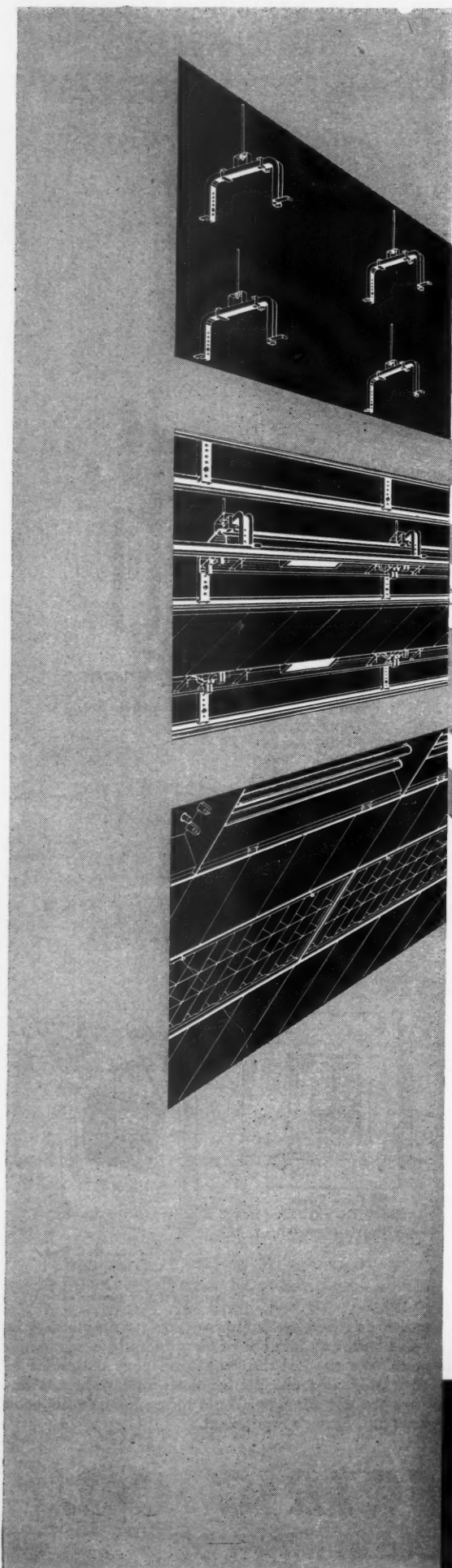
The ⑦ Panelboards shown above are some of the most popular types we design and manufacture. All ⑦ Panelboards carry the Underwriters' seal of approval and in general exceed material, workmanship and design standards by a wide margin. We also manufacture a complete line of power distribution panelboards and stage and auditorium lighting control panels.

⑦ Load Centers and Service Equipment are available now in many types and with any number of circuits up to a maximum of sixteen poles. We suggest that you urge your customers to install at least two extra circuits for those electrical conveniences they are waiting for now. Write today for free bulletins on Panelboards and Service Equipment.

# FRANK ADAM ELECTRIC CO.

Box 357

ST. LOUIS 3, MO.



## CEILINGS UNLIMITED

MILLER FLUORESCENT TROFFER LIGHTING SYSTEMS (continuous Wireway)—for stores, offices, schools, factories, and public buildings—open new vistas in architectural design. Their use makes it *engineeringly* (as well as *esthetically*) sound to plan entire buildings around the lighting.

The backbone of MILLER TROFFER SYSTEMS is the patented MILLER CEILING FURRING HANGER, which eliminates the necessity of laboriously fitting recessed lighting into hung ceilings. Instead, simply hang Miller Ceiling Furring Hangers from structural ceiling — and furring, tile, and TROFFER lighting systems are hung from the hangers. Old structural problems solved — no new ones created. And note these PLUSES — supports from structural ceiling reduced 50 to 75% — conduit and conduit fitting costs reduced up to 80% — wiring costs reduced up to 50% — with substantial economies in permanent operation and in maintenance.

Limited only by the architect's imagination, MILLER FLUORESCENT TROFFER LIGHTING SYSTEMS, simple to install, mark a new high standard in lighting service — CEILINGS UNLIMITED.

THE MILLER COMPANY • MERIDEN, CONN.  
Illuminating Division

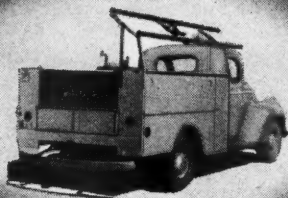
• HEATING PRODUCTS DIVISION  
• ILLUMINATING DIVISION

• ROLLING MILL DIVISION  
• FOUNDRY DIVISION





# American



Type 4480 for General Service and Meter Installation... features generous side compartments and open bed construction. Type 4480 bodies are built in 3 basic lengths and can be mounted on almost any truck chassis with capacity ratings from  $\frac{1}{2}$  ton to  $1\frac{1}{2}$  ton.

## CREW EFFICIENCY

Proper selection of equipment from American's complete line.  
Equipment readily accessible.  
Supplies conveniently arranged within easy reach.  
Good ventilation.  
All-weather protection.

## LOW COST PER MILE

Efficient design and application of welded formed steel sections result in greater pay loads.  
Great carrying capacity.  
Full utilization of space.  
Bodies outwear chassis as much as 3 to 1.

## EXCLUSIVE DESIGN

Offset side panels put ladders and pike poles within limits of body.  
Good load distribution.  
Derrick trough (less lifting).  
Platform extension.  
Material protecting roof design.  
Rattle-proof, tension-tight door with cam lock.

## Line Construction Bodies

### LOW COST PER MILE OF OPERATION

Full utility value plus efficient design, rather than trick gadgets and impractical ideas, has been American's 30-year policy. A scientific ratio of **WEIGHT, STRENGTH and DURABILITY**—due to special designs of formed steel sections... **CONVENIENCE**—due to unit control bins for tool storage... **SAFETY**—the result of American's experience in body design... all point to low labor and maintenance cost.

### JUST OFF THE PRESS!

Write for the new engineering-styled bulletin on American's Line Construction Bodies. Included are dimensions, sizes, equipment inventory. Mailed promptly upon request.

## Line Construction Bodies



American Line Construction Body is the accepted design for utility companies. Exclusive features pictured above are listed at the left. American makes six basic length models for every utility requirement.

**THE American COACH and BODY COMPANY**  
9503 WOODLAND AVE., CLEVELAND 4, OHIO

"Baker American" . Baker Equipment Engineering Co., Richmond, Va. . Sales and Assembly





# ILLINOIS PORCELAIN WIREHOLDER INSULATORS

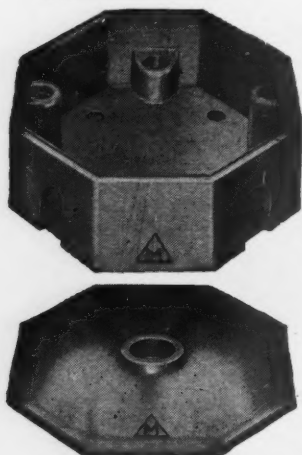
*Insure*  
SAFE  
HOUSE SERVICE  
CONNECTIONS..

• When you use Wireholder Insulators with the name "ILLINOIS" you are backing up your work with the right quality for the job.

All corners are rounded to prevent injury to the insulation of the wires. The screws have deep, sharp threads for easy installation. The screws are fastened into the insulators with non-shrinking metal alloy. The all-steel screws are hot galvanized by a special process to insure a smooth, even coating. Will not cause rust streaks on the sides of buildings. These dry process wireholders are made in sufficient styles and sizes to meet all requirements. Wet process porcelain supplied on special order.



## OUTLET BOXES



Glazed and unglazed styles conforming to all existing standards of dimensions, spacing, position of knockout holes, and mounting screws. High mechanical and electrical efficiency.

## ALL-PORCELAIN ILLINOIS SYSTEMS *for*



## SWITCH BOXES

Insure greater safety in wiring and the elimination of all grounding hazards. Made of the best quality of white porcelain. Metal inserts are placed in two holes of the switch boxes for receiving screws of standard switches, plug outlets, etc. Knockouts for single wires, also for cables. Specify and use them.

*outstanding, adequate and  
modern wiring jobs*



## KNOB

Cement coated — extra length nail—genuine leather washer — code standard. They don't chip when driven in and they do stay in place and have a firm grip. Available in a wide variety of heights, diameters, holes, and grooves.

## STANDARD TUBES

In sizes 1/2 to 48 inches, 5/16 to 3 inches diameter in following types: unglazed, glazed, split, floor, split floor, headless, curved and, crossover split, and cross over. Diameters all uniform both inside and outside.



ILLINOIS ELECTRIC PORCELAIN COMPANY *Macomb, Illinois*

# Standard

TRADE MARK

## Dry type, air cooled TRANSFORMERS

**Designed and built  
to your specification**

STANDARD gives the electrical manufacturing industry a service that is hard to duplicate. Engineering and production facilities are coordinated to quickly design and manufacture transformers of voltage, capacity, frequency, dimensions and mounting facilities to meet even the most unusual requirements.

The same high accuracy and fundamentally sound construction are yours whether you require one or a thousand transformers.

For power and control of your cranes, elevators, machine tools, furnaces, etc., specify STANDARD transformers. A letter, phone call or wire will quickly produce a solution to your transformer problem.

OVER 25 YEARS  
OF TRANSFORMER  
ENGINEERING

### THE STANDARD TRANSFORMER CO.

WARREN • • • OHIO

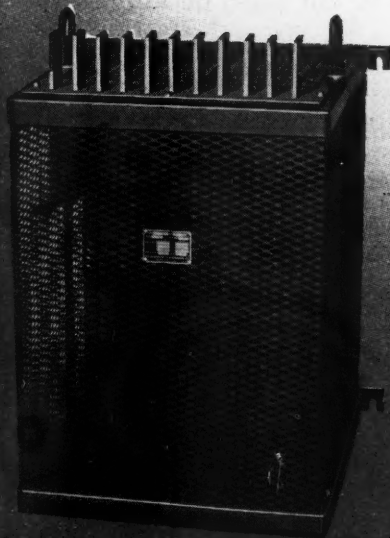
MAKERS OF POWER, DISTRIBUTION, INSTRUMENT, STREET LIGHTING  
AND TESTING TRANSFORMERS • • OIL, ASKAREL OR AIR COOLED

*Offices in Principal Cities*

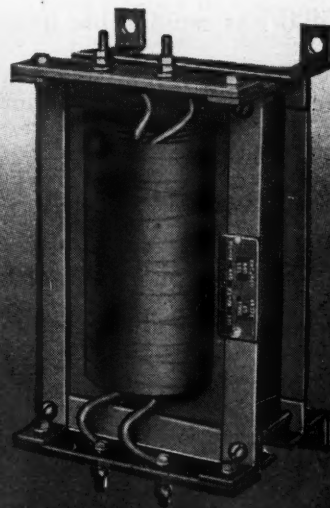
Typical design for wall or switchboard mounting, air cooled, up to 2400 volts, 25 KVA and less. Made with either Class A or Class B insulation.



Compartment filled type with enclosed terminal chamber, conduit bushings, wall or switchboard mounting. Dimensions may be varied to fit requirements of available space.



Multi-tapped transformer for power supply to small electric furnaces. Glass insulated for Class B (90° C. rise) construction.



Shell type construction, bracket mounted transformer, low capacity, low voltage for controls or power supply of machine tools. Made without case for mounting in or on equipment.

# NATVAR No. 400

## Can Take Soldering Operations



New York Transformer Company's Type 11071 is a self-regulating power supply transformer. This interior view shows leads protected by NATVAR No. 400 high-heat-resistant extruded vinyl tubing before hermetic sealing in potting compound at elevated temperature.

NEW YORK TRANSFORMER COMPANY uses NATVAR No. 400 tubing in this rugged, high-efficiency transformer to provide maximum protection for the leads. When these leads are soldered to the pins, the tubing does not have to be cut back, because NATVAR No. 400 has remarkable heat resistance.

There are many other superior characteristics of NATVAR No. 400 which make it worthy of consideration for applications wherever extruded vinyl tubings can be used to advantage.

Write, wire or phone us for full description and specifications. We can deliver immediately either from the stock of a wholesaler near you, or from our own.



- Varnished cambric — straight cut and bias
- Varnished cable tape
- Varnished canvas
- Varnished duck
- Varnished cellulose acetate
- Varnished special rayon
- Varnished Fiberglas cloth
- Varnished papers
- Varnished tubings and sleeving
- Varnished identification markers
- Lacquered tubings and sleeveings
- Extruded vinyl tubing
- Extruded vinyl identification markers

Write for Catalog No. 20

# THE NATIONAL VARNISHED PRODUCTS

TELEPHONE  
RAHWAY 7-2171

CABLE ADDRESS  
NATVAR: RAHWAY, N. J.

*Corporation*

205 RANDOLPH AVENUE

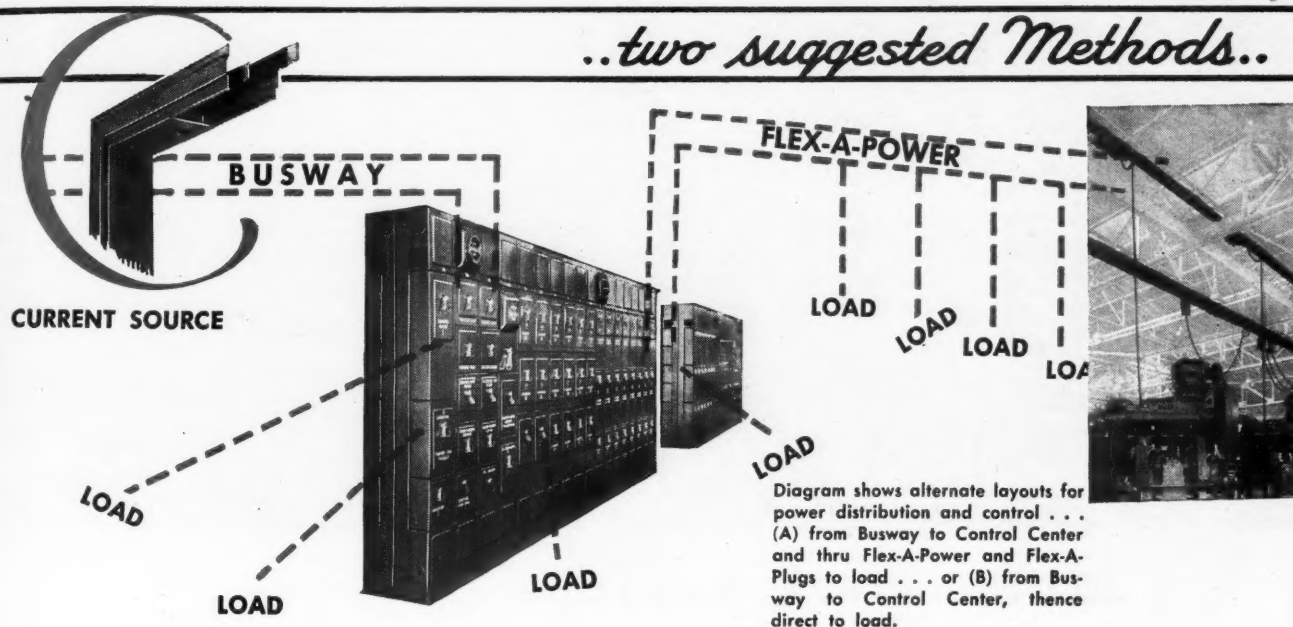
★ WOODBRIDGE NEW JERSEY



# TRUMBULL

## INDUSTRIAL POWER DISTRIBUTION

*..two suggested Methods..*



### THREE PREFERRED PRODUCTS

**T**RY as hard as you will in planning an Electrical Distribution System and you'll wind up with three preferred products . . .

- (1) **BUSWAY** . . . for your heavy duty electrical highways from transformer secondaries . . . or from main to sub-distribution control points . . . also quite frequently as a medium for inter-connection of two switchboards thru a bus-tie breaker. Capacities from 600 to 4000 amperes although 2000 ampere feeders (maximum) are desirable from an economical viewpoint.

- (2) **FLEX-A-POWER** . . . for distribution to loads. The 225 ampere size will be your "best buy".
- (3) **CONTROL CENTER** (preferred over conventional distribution panelboards) . . . which receives its power from (1) and then distributes that power thru (2) . . . or, depending upon type of occupancy, direct to load.

These Trumbull Products are now serving many plants whose names read like a veritable roster of Industry's "Who's Who". You can't go wrong in following suit.

**THE TRUMBULL ELECTRIC MANUFACTURING CO.**  
PLAINVILLE, CONNECTICUT

OTHER FACTORIES AT

NORWOOD, OHIO — LOS ANGELES — SAN FRANCISCO — SEATTLE

Electrical Contracting, April 1946

# THE REFLECTOR IS THE BACKBONE OF ANY LIGHTING SYSTEM...



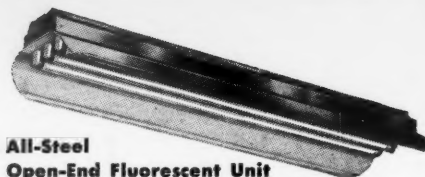
## Skilled Work Needs *Skilled Lighting*

Blinding glare and uncertain shadow – by-products of faulty lighting – can mean costly production errors in plant operation. Give workers the help they need... a clear, even distribution of light... *Skilled Lighting*, the product of Wheeler's 64 years of specialized light engineering.

Wheeler Units are *engineered* to provide maximum light from standard lamps. Their high reflection factor puts light to work where it belongs – on the job. Their rugged construction insures long service – easy maintenance.

Learn how you can lighten workers' load with *Skilled Lighting*. Send for catalogs showing complete line of incandescent and fluorescent lighting fixtures. Wheeler Reflector Company, 275 Congress St., Boston 10, Mass. Also New York. Representatives in principal cities.

*Distributed Exclusively Through Electrical Wholesalers*



**All-Steel  
Open-End Fluorescent Unit**

Available for two or three 40-watt, or two 100-watt lamps. Broad wiring channel with accessible, enclosed ballast. Can be mounted from chain or conduit, individually or in continuous runs.



**RLM Solid Neck Incandescent Reflector**

Maximum lighting efficiency for either indoor or outdoor use. Expertly designed, ruggedly built. For 75 to 1500 watt lamps.

# Wheeler

## REFLECTOR COMPANY

LIGHTING EQUIPMENT SPECIALISTS SINCE 1881

# Chelsea Ventilating Coolers for Home, Office, Factory or Store!



## PLAN NOW

The demand for modern ventilating units to provide "tops" in ventilation for all types of residential construction is increasing. They must afford quiet, efficient ventilation and operate with maximum economy. All Chelsea equipment is backed by 20 years of experience in fan and blower construction. Specifying Chelsea for your ventilation means providing the most in ventilation.



### TYPE IND STREAMLINED INDUSTRIAL FAN:

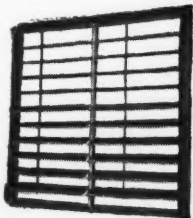
For heavy duty ventilation requirements—factories, sports arenas, theaters, institutions, etc. Streamlined venturi orifice provides greater efficiency in dust work or against automatic louvers. Easily installed, low power consumption. Ball bearings on motor and shaft; die balanced, die-stamped blades. Rugged all-steel frame and efficient certified ratings.

### TYPE ED STREAMLINED ATTIC FAN:

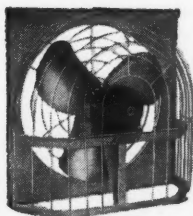
For cooling homes, churches, hotels, hospitals, schools, etc. Streamlined construction throughout, rolled-steel venturi orifice provides greater efficiency under static pressure. Four die-cast, die-formed balanced blades of heavy steel eliminate vibration. Ball bearings, totally enclosed ball-bearing motor, certified ratings. Moving parts are rubber cushioned.



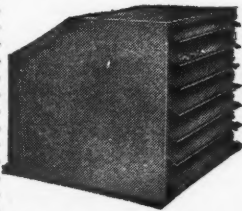
## INVESTIGATE THESE WIDELY-USED CHELSEA VENTILATING UNITS



**Type LWL Automatic Louvers:** For general ventilation installations. Protects fan when not in use. Aluminum leaves pivoted in machined brass to reduce friction; tie rods cadmium plated bushings. Larger units dual to eliminate twisting of leaves.



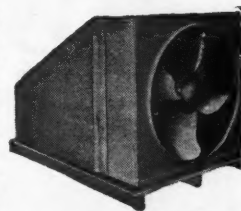
**Type AA Utility Fan:** For cold storage, meat packer and freezer applications. Totally enclosed ball bearing motor with both front and rear guards. Capacity: AA20—3000 CFM; type AA24—4800 CFM. Fan speed—1100 rpm.



**Type PH Penthouse Roof Ventilator:** For roof ventilation. Operates against static pressures using the IND type industrial fan housed in steel penthouse with automatic shutters. Completely assembled—ready for installation.



**Type P and MC Pedestal Fans:** For shops, offices, stores, and factories. Rugged construction with steel die-stamped blades. Motor and fan shaft ball bearings. All parts protected against rust. Available in a wide range of sizes.



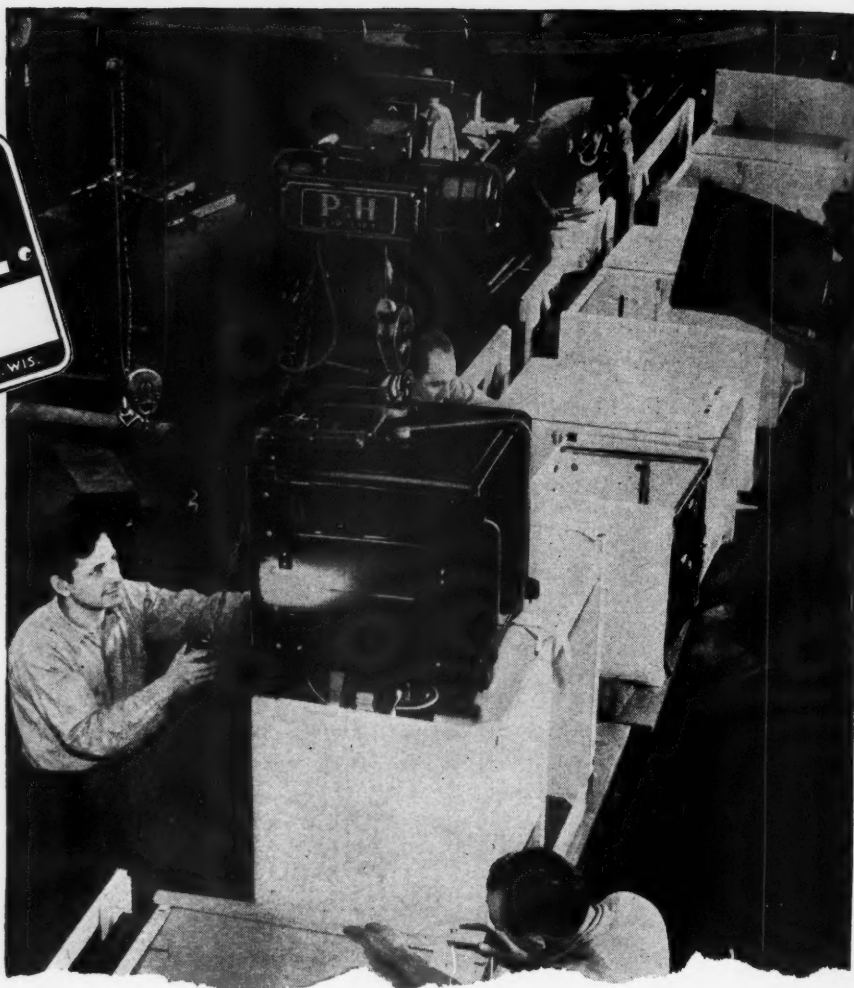
**Type EU Package Attic Fan Unit:** For cooling homes, churches, hotels, hospitals, schools, etc. New streamlined venturi orifice delivers greater air volume. ASH and VE method certified ratings. Efficient, low current consumption motors.

CHELSEA

**CHELSEA PRODUCTS**

1206 GROVE STREET, IRVINGTON, NEW JERSEY





**COST-SAVER**

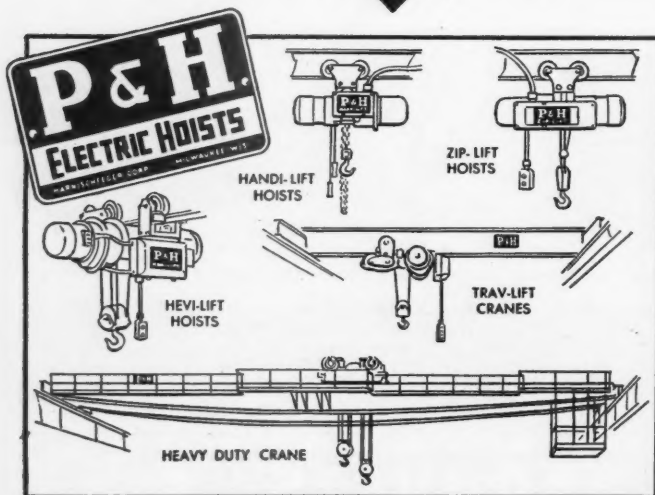
**ON ASSEMBLY LINES, TOO!**

**"THRU-THE-AIR"** handling speeds production —

Here's a case of one back-saver helping to build another . . . a P&H Zip-Lift Hoist placing the "inners" in electric dishwashers. It's an assembly line operation—so *speed* is a must. Equally important is the gentle, *precision* "spotting" of the load.

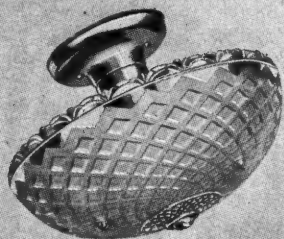
Jobs of this kind are made to order for Zip-Lifts. Traveling "thru-the-air" they move direct—over assembly lines—leaving all floor space for production. Smooth electric power makes it *easy* . . . push buttons provide *accurate control* . . . an unbeatable combination for the production line.

But P&H Zip-Lifts are far more than an assembly line aid. "Thru-the-air" handling speeds the flow of materials throughout the plant—from raw to finished state! A P&H Hoist Engineer will gladly demonstrate. Call him in . . . or write for free Zip-Lift Bulletin!



**HARNISCHFEGER CORPORATION**  
HOISTS • WELDING ELECTRODES • MOTORS • EXCAVATORS • ELECTRIC CRANES • ARC WELDERS

General Offices: 4426 W. National Ave., Milwaukee 14, Wis.



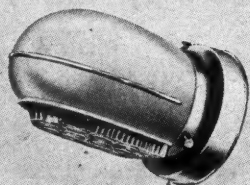
BEDROOM



DINING ROOM



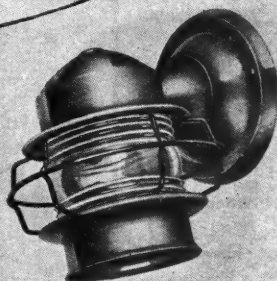
LIVING ROOM



BATH  
ROOM



KITCHEN



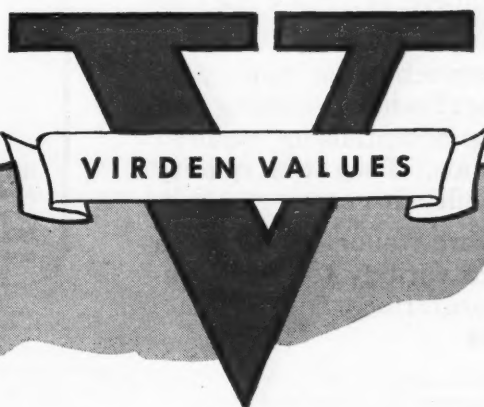
OUTDOOR

## Lighting Fixtures for Small Homes

Some of the "Virden Value" lighting equipment for the small homes market is shown in this announcement.

Inexpensive, yet winning sincere admiration and appreciation everywhere by their complete adequacy and simple beauty—these "Virden Value" designs feature thoroughness of construction, ease of mounting and handsome finish. You can get them now!

Virden wholesalers will give your orders prompt service.



**John C. Virden Company • Cleveland, Ohio**

*Member American Home Lighting Institute*



# AMERTRANS

provide multi-voltage distribution in plants of

# CROCKER-WHEELER



This 750 K.V.A. oil-immersed AmerTran provides general plant distribution at 2300 volts, 3 phase, 60 cycles.

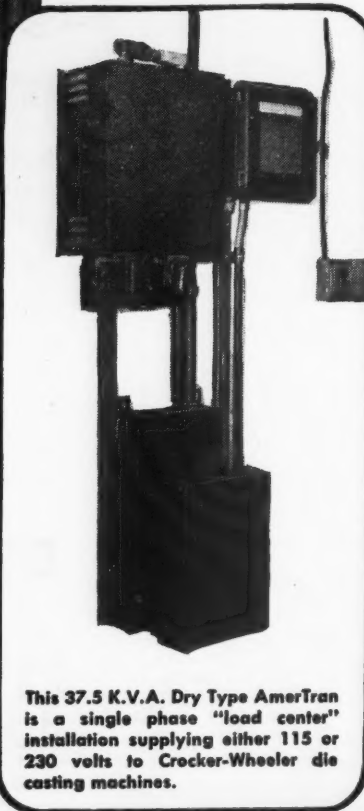
Among the AmerTran Transformers in the plants of Crocker-Wheeler Electric Manufacturing Company (Division of Joshua Hendy Iron Works) at Ampere, N. J., are the two types shown here.

In ranges between these two types are other AmerTrans, furnishing current at various potentials for required power demands. They are quality products—built with care.

AmerTrans are tailor-made in a plant devoted entirely to the manufacture of transformers and associated equipment.

## AMERTRAN ADVANTAGES

- High turn-to-turn insulation
- Linear surge-voltage characteristics
- Fully balanced coil design
- Coils vacuum impregnated
- Rigid, core construction
- Optimum impedance
- "Tailored tanks"
- Electrically brazed connections
- Rust resistant external parts



This 37.5 K.V.A. Dry Type AmerTran is a single phase "load center" installation supplying either 115 or 230 volts to Crocker-Wheeler die casting machines.

**AMERICAN TRANSFORMER COMPANY**  
178 Emmet St. • Newark 5, N. J., U. S. A.

# AMERTRAN

MANUFACTURING SINCE 1901 AT NEWARK, N. J.

Pioneer Manufacturers of Transformers, Reactors and Rectifiers for Electronics and Power Transmission

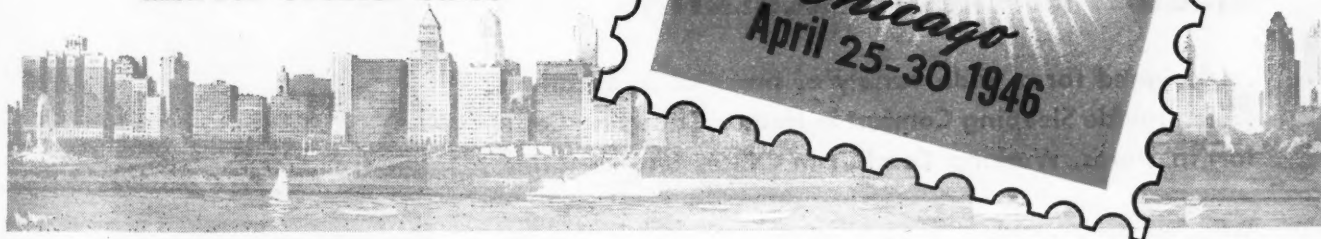




# Plan Now to Attend!

**SEE the Latest  
in the World of  
Lighting!**

See How Lighting Contributes to  
Better Seeing  
for Improved Production  
and for Greater Sales



**A Complete Exhibition of Post War Lighting for Industry, Business, Stores, Offices,  
Schools, Service Stations, Play Areas, Airports and Streets**

The International Lighting Exposition and Conference will be the mecca next April for thousands of architects, electrical contractors, electric light and power personnel, consulting engineers, building managers, industrial and commercial executives, wholesalers and dealers.

This Exposition and Conference will provide you with the first opportunity in five years to really "catch up" with the amazing developments in the field of commercial and industrial lighting. In addition to the new,

better and more efficient lighting units, there will be many interesting and informative displays, such as those by the Illuminating Engineering Society and manufacturers of products which assist in proper lighting.

Equally important is the series of lighting conferences to be held on Friday, Saturday, Monday and Tues-

Exposition open

12 Noon to 6 P. M., Fri. Sat., Sun., Mon. and Tues.

**STEVENS HOTEL  
CHICAGO  
April 25-30**

day, April 26, 27, 29 and 30. Outstanding men in the industry will discuss latest trends and practices in lighting. There will be a special session on sales methods for electrical contractors and wholesalers.

**Don't Miss This Program of Lighting Conferences**

**26 FRIDAY**

New Lighting Trends  
and Methods  
9:30 a.m. to 12:30 p.m.

**27 SATURDAY**

Lighting Sales Forum  
for  
Electrical Contractors  
9:30 a.m. to 12:30 p.m.

**29 MONDAY**

Industry Conference  
on Lighting Service and  
Lighting Sales Training  
9:30 a.m. to 12:30 p.m.

**30 TUESDAY**

Lighting  
Application  
Forum  
9:30 a.m. to 12:30 p.m.

For further information, write International Lighting  
Exposition, 111 West Jackson Blvd., Chicago 4, Ill.

## INTERNATIONAL LIGHTING EXPOSITION

**VISIT THE WESTINGHOUSE EXHIBIT • BOOTHS 52 TO 58**

# MAKE IT HIGH



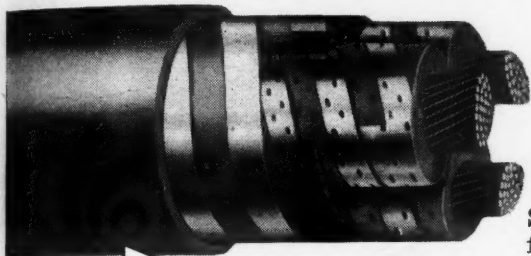
## PACEMAKER IN WIRE PRODUCTS

WEATHERPROOF WIRE • SERVICE ENTRANCE CABLES • RUBBER COVERED WIRES AND CABLES (INCLUDING THIN-WALL INSULATED BUILDING WIRES AND CABLES) • RUBBER SHEATHED PORTABLE CABLES • RUBBER INSULATED POWER CABLES • MAGNET WIRE • TELEPHONE WIRES • PIGTAIL AND BRAIDED COPPER • BARE COPPER STRAND TROLLEY CONTACT WIRE • VARNISHED CAMBRIC POWER CABLES

# ROE

## ELECTRICAL

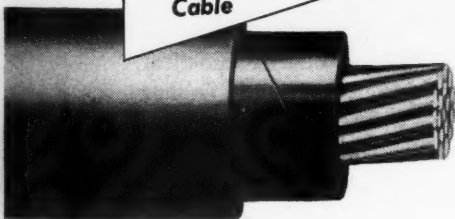
# VOLTAGE *ALL THE WAY* *for lower losses... higher capacity*



Roebling  
Paper Insulated Cable

FROM GENERATOR TO  
UNIT SUB-STATION

Roebling Varnished  
Cambric Insulated  
Cable



## WITH ROEBLING POWER CABLES

STEADILY INCREASING LOADS are focussing new interest in bringing high voltage power all the way to unit sub-stations. Lowered power losses and greater current carrying capacity are among the opportunities opened up. And in handling loads like these, Roebling power cables have earned a reputation for performance among utility engineers and electrical contractors alike.

At voltages from 13,000 to 33,000 for 3-phase grounded neutral circuits, for example, consider Roebling Paper Insulated Cable (Shielded Type H). It provides the simplicity of installation and maintenance that only a "solid" type cable can give, plus high current carrying efficiency.

For voltages up to 17,000 between phases . . . and up to 26,000

for single conductor grounded neutral (for power, heat or lighting circuits) the choice is Roebling Varnished Cambric Insulated Cable. In sub-stations, mines, industrial plants—wherever operating temperatures are high—it's preferred for transformer and oil switch leads, as well as generator and motor leads.

Both types meet the fundamental considerations of *safety*, *adequacy* for the required service, and unquestioned *reliability* . . . as do *all* Roebling electrical cables. It's a combination of research and engineering, materials and methods that assures this result.

Call in a Roebling engineer. He can show you more than one way of solving high-voltage cable problems to your advantage.

JOHN A. ROEBLING'S SONS COMPANY

TRENTON 2, NEW JERSEY

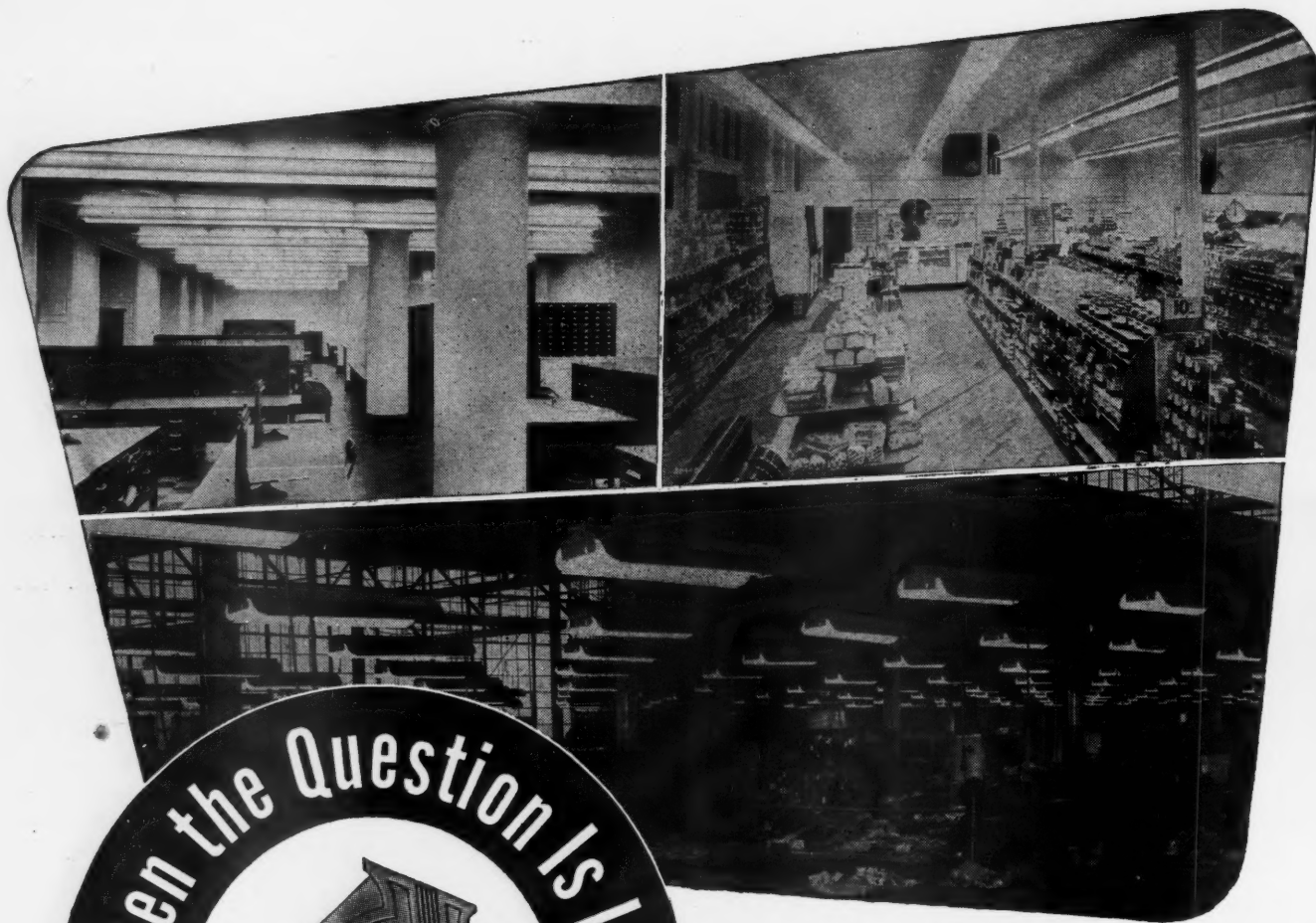
Branches and Warehouses in Principal Cities

# BLING



WIRES AND CABLES





GUTH FUTURLITERS in the above photos demonstrate the "Keyed to the Specific Lighting Job" features of GUTH FLUORESCENT. FUTURLITERS are providing the quality and quantity of light required both in office and in store. GUTH Egg-crate Louvres have been added to the FUTURLITERS to provide additional lamp shielding for the more exacting "seeing" job in the office.

### **"Keyed" to the Specific Lighting Job!**

The "Know-How" gained during 44 years in Lighting, is built into GUTH FLUORESCENT in tangible quality features, to meet the requirements of any specific lighting job, whether in office, store, factory, school or institution.

The GUTH FLUORESCENT line offers a practical selection of high-performance reflector finishes and reflector types for correct light distribution; proper lamp shielding, built-in, or with louvres or baffles; efficient diffusion, with glass or plastic diffusers. And GUTH FLUORESCENTS are modern-

ly styled in a full range of the newest luminaire developments.

Thus, with GUTH FLUORESCENTS, you have a wide choice of the variables, that control the quantity and quality of light, to assist in the fine engineering required in today's lighting installations.

Data on above Photos: In OFFICE, GUTH FUTURLITERS provide 68 F. C. using 2.3 watts/sq. ft. Mounted in rows spread 8'0" apart on 11'0" ceiling.

In STORE, GUTH FUTURLITERS, deliver 64 to 75 F. C. using 3-40W fluorescent lamps per section. Mounted at 9'0" from 12'0" ceiling in rows 8'0" apart.

In FACTORY, GUTH MAZELITES, afford 30 to 32 F. C. of good working light. Mounted 9'6" high on 7'6" centers in rows 9'6" apart.

# **Guth FLUORESCENT**

**LEADERS IN LIGHTING SINCE 1902**

THE EDWIN F. GUTH COMPANY • 2615 Washington Ave. • St. Louis 3, Missouri



# QUALITY

## CENTRAL RIGID STEEL CONDUIT

*"There's Tested Strength in Every Length"*

**SPANG-CHALFANT**

Division of The National Supply Company

General Sales Office: Grant Bldg., Pittsburgh 30, Pa.

District Offices and Sales Representatives in Principal Cities



# LOAN TO BRITAIN

## ... *Investment in World Economic Unity*

**C**ONGRESS should give swift and confident approval to the proposed loan to Great Britain.

Few other issues of foreign policy in the present troubled world lend themselves to such clear appraisal of where our National interest lies.

In simplest terms, the question is whether we should extend to Great Britain a credit of \$3¾ billions (plus \$650 millions in payment for lend-lease balances) in return for her promise to repay principal with interest over a fifty year period starting at the end of 1951, and her pledge to give the fullest possible support to the kind of world trading system which it is the declared policy of both the United States and the United Nations Organization to promote.

### **We Can Afford to Make It**

The sum we hazard is not inconsiderable, but financial risks have meaning only when related to resources. The line of credit provided by the loan will amount, at most, to a claim on 2/5 of 1 per cent of our gross output for the five to six year period over which it may be used. The interest rate charged, while moderate, is higher than our Treasury is paying upon current borrowings. The risk entailed is well within our resources as a creditor. In the considered judgment of the American and British technical experts who thrashed through the intricate accounting for three painful months, the amount and terms offered will suffice to allow Britain, under rigid austerity, to relax her system of foreign trade restrictions, and to expand exports sufficiently to pay her debt commitments.

Against the considered risks of extending the loan, there must be weighed the certain costs of refusing it. Without the loan, Britain has no recourse but to maintain and extend the system of bloc trading which she adopted under stress of world depression and world war. If that is the route Britain follows, she will carry with her a large part of the sterling area countries—all British Commonwealth and Empire countries (except Newfoundland and Canada) plus Egypt, Iraq, and Iceland—and many of the nations with which the United Kingdom has payment agreements (Argentina, Bolivia, Brazil, Chile, Paraguay, Peru, Uruguay, Belgium, Czechoslovakia, Denmark, Finland, France, Netherlands, Norway, Portugal, Spain, Sweden, and Turkey).

Altogether, the United Kingdom's orbit accounts for more than half of the world's imports

and exports combined. It likewise is crucial to the trade of the United States. In the years immediately preceding the war, the sterling area and payment-agreement countries provided just under one-half of both the import and export trade of this country.

Russia, of course, will continue to conduct her foreign commerce exclusively upon a state-trading basis. Before the war, the Soviet Union transacted only a little more than 1 per cent of foreign trade business, but its future sphere of influence will be large—conceivably embracing as much as 30 per cent of total international trade.

### **We Cannot Afford to Refuse It**

If the weight of British influence in foreign trade is thrown toward the Russian pattern rather than toward ours, it is apparent that bloc trading, with all of its supporting devices—bilateral deals, exchange controls, import and export quotas, subsidies, currency manipulations and the like—will be the prevailing pattern for foreign transactions.

In self-protection, the United States would have no alternative but to conform to the dominant pattern. We should be forced to form our own bloc, and to enter into active economic warfare in bidding for trade concessions against the offers of our rivals. How well we would do this is problematical. To the game we would bring the largest economic potential in the world. But our handicaps would be equally impressive.

First, under a system in which political and economic motivations are inextricably fused, a democratic nation, and particularly one with a tradition of freedom in its domestic enterprise, would operate at a great disadvantage. We should inevitably be driven toward more and more government control of our entire economy.

Second, with a pattern of foreign trade in which our exports habitually are greater than our imports, our bargaining position in international trade is much weaker than our over-all economic strength would suggest. Under state-controlled trading we should still find it difficult to compete successfully without resort to loans, and under these conditions our loans would be supporting a system alien to our choice and interest.

Third, under a regimented system which made economic decisions subservient to political considerations, it is virtually certain that the volume of world trade would shrink. That was the clear experience of the nineteen-thirties. Thus, the



standard of living in the United States would suffer in common with all others, and we would be forced into a particularly drastic curtailment of certain war-expanded segments of our economy, at the very time when a large portion of the world is most in need of the products they can produce.

### **Weighing the Alternative Costs**

In the years immediately ahead it is certain that from two-thirds to three-quarters of all international trade will be transacted either in pounds or dollars. If both circuits are linked in a determined effort to restore competitive world markets, to which buyers and sellers alike have access without discrimination, that will be the dominant system of foreign trade. If the sterling group with its satellites organizes a closed grid, our exclusive effort cannot preserve the trade pattern that we believe offers most to us and to the world.

No one can accurately measure the costs to the United States of refusing the loan and accepting the consequences. But unquestionably they would dwarf to insignificance the sum risked in the proposed credit. We would lose through the shrinkage of our trade, through the wrench of violent readjustments in our production patterns, and eventually through the curtailment of our over-all output below what it would be under an open rather than a closed system. We would lose heavily in economic liberty under a procedure that can be followed with success only by a close regimentation of production as well as trade.

Most of all, we would lose in prestige, through demonstrating that we are still unprepared to exercise a world leadership to which our giant stature as the possessor of almost half of the world's economic capacity entitles us. Once again we would be exhibiting to the world political feet of clay supporting an economic frame of heroic proportions.

### **It Is Far from a "Soft" Bargain**

There has been some disposition in this country to regard the loan to Britain as a somewhat "soft" and generally unprecedented transaction that smacks of charity. This is the sheerest nonsense.

In the first place, the kind of economic system we want has never functioned and cannot operate now without a lender. For many decades prior to World War I Great Britain filled the creditor role. In 1913 her foreign investments totaled \$19 billions, and she not only made such transactions pay, but they proved her salvation through two grim wars. Her credits helped in the industrial development of a large segment of the world, including the United States. Of all the nations in the world, only the United States can assume now the mantle which Britain no longer can support.

In the second place, the terms of our proposed loan to the United Kingdom are far from easy. Britain put a substantially greater proportion of her relatively meager resources into the war than we did, and dissipated a large share of her foreign holdings in the process while accumulating an outside debt of crushing magnitude. On a per capita basis her internal debt is greater than ours. Many Britons feel that our proposed loan is too small, and its terms too rigorous. If the amount proves to be inadequate, we shall have to consider supplemental aid at a later date. But the majority believe that the present offer gives a fighting chance to restore the system of world trade that we and they both want, and upon which the World Bank, the Monetary Fund, and the International Trade Organization under United Nations aegis are based. It is certain that without our loan all of this will go by the board.

In the third place, our proposed loan is far from being without precedent. Canada, which is linked by far closer economic ties to us than to the Empire, already has provided for a loan to Britain of \$1,200,000,000. This amounts to almost a third of what we propose to lend, although Canada's population is less than 10 per cent, and her income is little more than 5 per cent of ours.

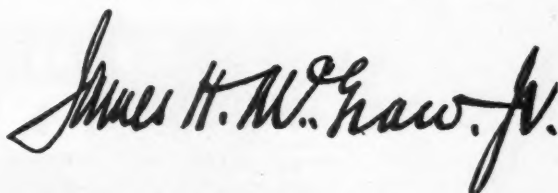
### **Shall the United States Lead or Follow?**

The way to exercise leadership is to lead. Nothing could be more futile than to go half way toward establishing the economic order for which we stand, and then withhold the crucial measure that will make it work. Failure to approve the loan to Britain will be a clear default of leadership. Failure to approve it promptly will dissipate its effectiveness.

It has been officially stated that the British loan is a unique case that will establish no precedents for further credits to other nations. It is exceptional in its importance to our aim. But if the United States expects to make its economic program the dominant one for world trade, it must continue to exercise the creditor function without which that program cannot persist.

The most that we should ask is that future loan transactions be scrutinized as was this one to see that they offer comparable security and comparable return in support of the program for which we stand.

For the loan to Britain, it can be said that never before has one nation had an opportunity to gain so much at so little risk as has the United States in this uniquely decisive case.



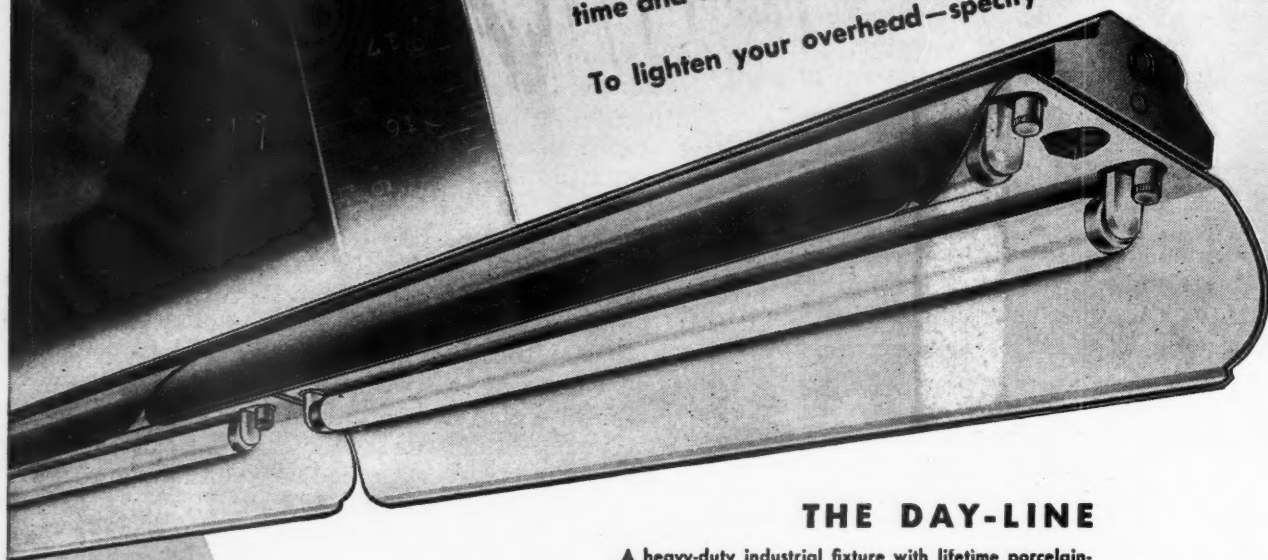
*President, McGraw-Hill Publishing Co., Inc.*



# GIVE HIM THE MISSING TOOL... *Better Light*

Straining the eyes reduces accuracy and output.  
Day-Brite industrial fixtures are optically engineered  
to give better light. They increase plant efficiency, save  
time and energy.

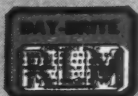
To lighten your overhead—specify Day-Brite.



## THE DAY-LINE

A heavy-duty industrial fixture with lifetime porcelain-enameled steel reflectors. Designed for two and three 40-watt and two 100-watt lamps... single unit and continuous installation. Patent Nos. 2317434, D135375, D133458.

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Nationally distributed through leading electrical supply houses.  
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949

IT'S EASY TO SEE WHEN IT'S

# DAY-BRITE

*Lighting*



# APRIL . . . . at a Glance

## Construction

Restored construction controls give C. P. A. officials wide powers to halt "non-essential" building—see page 171—but do not mean a shut-down of industrial and commercial construction. Jobs will be processed by local offices. If they require materials actually holding up housing in the area, they will probably be rejected. If not, chances are they will get a quick go-ahead. There is still an appeal to Washington on rejected projects with the probability of very liberal treatment there. Though shortages are acute, no housing is actually stopped for want of electrical materials, so electrical jobs generally will probably clear easily. It is still too early, however, to estimate how much effect the delay and red tape will have on this year's business.

## Reprints

A limited quantity of reprints of last month's editorial feature section "Residential Wiring" are still available. The price is 25 cents each. We've heard that some contractors have found the material useful when discussing plans with owners and architects. Get your order in early.

## Minnesota

Gus Eckel's report on the North Central Electrical Industries meeting,

page 177, is a necessarily brief report on what has become the greatest regional activity in the country. Co-operating groups from all branches of the industry stage concurrent sessions of their own groups, combine with others to discuss important all-industry topics and to stage a large trade show. It is not surprising to find that trade relations in the area are exceptionally good and when there's a promotional job to do, everybody's got his back in it. A noteworthy point, the hub of the whole enterprise is the Minnesota Electrical Council, a contractor group.

## Engineer-Artist

The lighting applications in this issue were sketched by Ted Mehrer, New York engineer-designer, who has been designing lighting equipment for over 20 years. His clients include an imposing array of lighting equipment manufacturers. His jobs include steel works and homes, seminaries and munition plants, an impressive list as long as your arm of buildings and projects, many of which are nationally famous. You've seen his sketches before in last October's "Planned Lighting" section and last month's "Residential Wiring". His work has such artistic quality that we are inclined to forget, sometimes, that this is all real equipment of metal and glass and wire and sockets, that behind the handsome design is good practical

engineering from a background of experience and sound technical judgment. But that's lighting for you. It needs both the engineer and the artist.

## G. I. Credit

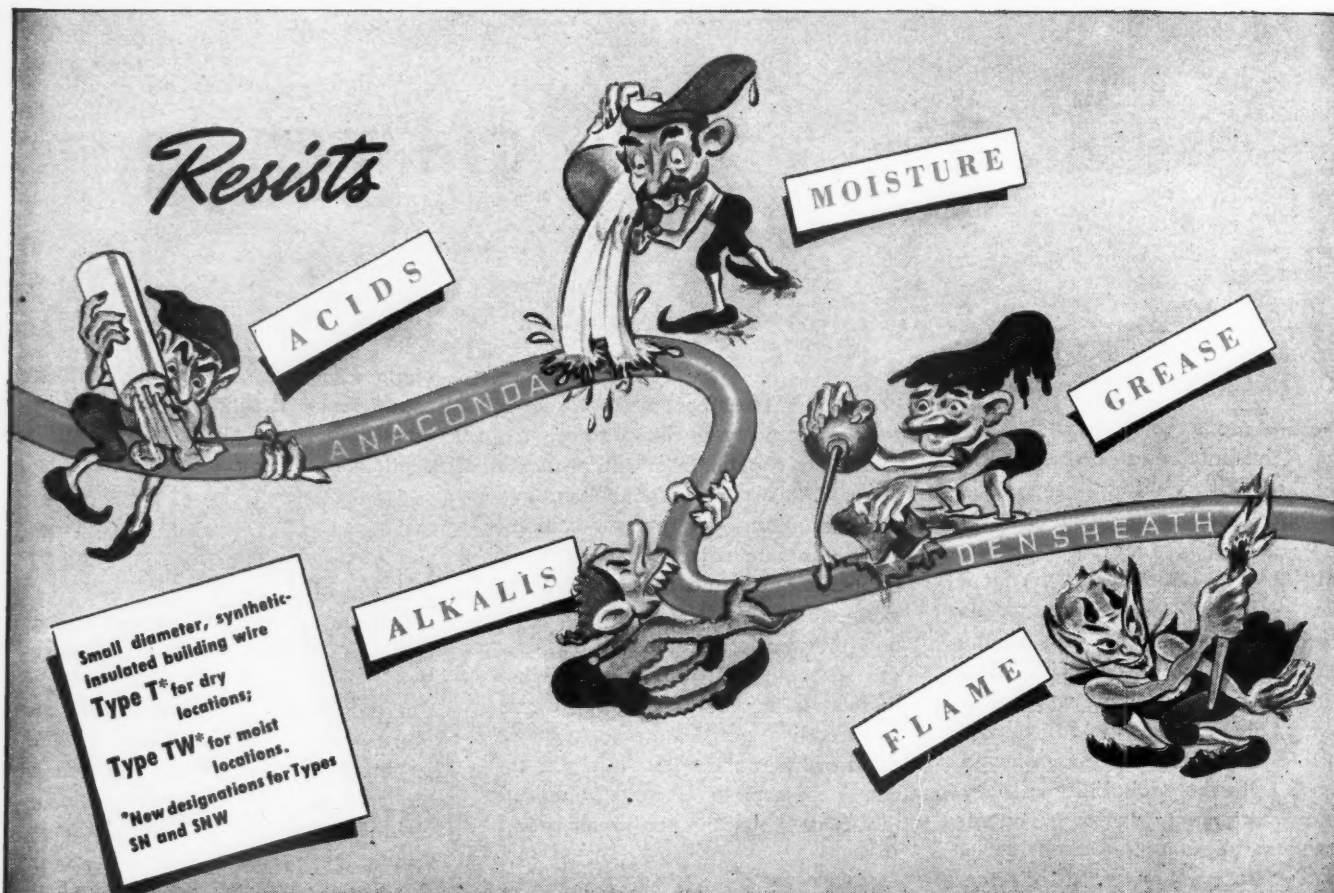
Everybody admits that specialized electrical training in the armed services ought to carry some weight in apprentice programs and license requirements. Credit on a logical and systematic basis, however, is essential if Army or Navy training is to be weighed fairly. A Joint Industry Committee is working on the job in Minnesota. They are setting up specific recommendations for training credit based upon Service schooling and experience as it applies to apprenticeship and state license. It may well be a model plan for other states. Watch for the story in our May issue.

## Grounding

For all of its apparent simplicity, grounding of apparatus and circuits demands a high order of know-how and skill. With industrial wiring distribution systems headed upward in voltage and current values, good grounding practices take on increasing importance. In this issue L. G. Levoy's article "Grounding Industrial Power Systems", page 78, contains timely data on industrial grounding practice.



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it's the outstanding wire for your normal needs**



# Densheath<sup>\*</sup> TYPE T & TW BUILDING WIRE

\*Reg. U. S. Pat. Off.

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**HIGH RESISTANCE**—To moisture, acids, alkalis, chemicals; mineral, animal and vegetable oils.

**FLAMEPROOF**—Will not ignite, burn or support combustion.

**UNUSUALLY PLIANT**—Has no "spring"; retains any bend.

**TENSILE STRENGTH AND ELONGATION**—Similar to values found in rubber compounds.

**SUPER-AGING**—Superior to any rubber compound in resisting ozone, oxygen and sunlight.

**DIELECTRIC STRENGTH**—Superior to that of usual grades of rubber insulation. Good resistance; low specific inductive capacity.

**MORE CIRCUITS PER CONDUIT**—For new installations, extensions and maintenance.

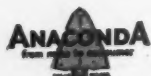
**ABRASION, TEARING, BENDING, FLEXING**—Resistance in keeping with other qualities.

**STRIPS EASILY**—Leaves bright conductor.

**EASY IDENTIFICATION**—Conveniently marked.

Wherever single or multiple control cables are open to severe conditions, Densheath also gets the call—for example, in wiring machine tools, equipment in acid treating plants, chemical plants. Can be had in a range of colors. Anaconda Wire & Cable Company, Subsidiary of Anaconda Copper Mining Company, 25 Broadway, New York 4, N. Y. Sales Offices in Principal Cities.

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**ANACONDA WIRE & CABLE COMPANY**

# SPECIFY QUALITY

Continuing material shortages, as we head into a major building and rehabilitation program, can have a serious effect on industry standards. And it will have, unless the men who specify and use electrical materials and equipment register a concerted demand for quality. Our industry is under tremendous pressure from politicians, lawyers, economists and a host of experts, who wouldn't know a hickey from a hack-saw, to cut costs indiscriminately. And the voices of those who know when high quality is the best economy are often lost in the babel of sociological double-talk.

The men who know materials and methods from training and experience have a critical responsibility to the public. They understand quality. But war shortages have cramped and inhibited expression in buying practice. Brand preferences are often ignored to expedite delivery. Quality requirements are frequently compromised to get the job done. We have become accustomed to accepting, more or less grudgingly, just about anything that will pass inspection in a pinch. Fortunately, there has been comparatively little quality deterioration in electrical materials, due, in some degree at least, to the simple fact that a lot of highly competitive items before the war were already down to bare minimum standards.

Product preference studies show, however, that even though they will accept substitutions in make and quality, electrical men still hold strong brand preferences and want materials in the better quality brackets. In spite of the high degree of standardization common in electrical materials, there are still substantial differences. Particular features of design, facilities for installation and maintenance, qualities of ruggedness, or a

history of dependability, usually meaningless to the layman, are important to trained and experienced electrical men. They are even more important now. We have had to put up with lesser qualities often over a long period of time. And the outside pressures for cheapness at any cost are growing stronger.

There is one way that we can register preference for brand and quality that will directly influence design trends and manufacturers' policies. That's in written orders and specifications. We are going to have to take what we can get for a while in some lines. But we ought to ask for what we want, clearly and definitely. That's the kind of language that attracts attention and is quickly translated into production schedules. And, fortunately, under present market conditions orders for the better quality materials are going to have preference in those schedules if there is any reasonable evidence of a real demand.

Specifications are stronger language than economic philosophy. With manufacturers' facilities loaded to capacity, schedules are going to follow orders on the books. The men who write the specifications and the orders have the future standards of the electrical industry in their hands. We have a responsibility to the public to specify quality. We have a responsibility to use our knowledge of brands and grades and technical features. And the way to do it is to specify and order by make and catalog number.

*Wm. J. Stuart*

## Electrical Contracting

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APRIL, 1946



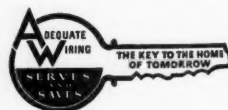
# Ventilation

GRAYBAR DISTRIBUTES ILG BLOWERS,  
PROPELLER FANS, ACCESSORIES...OFFERS  
SPECIALIZED HELP TO CONTRACTORS

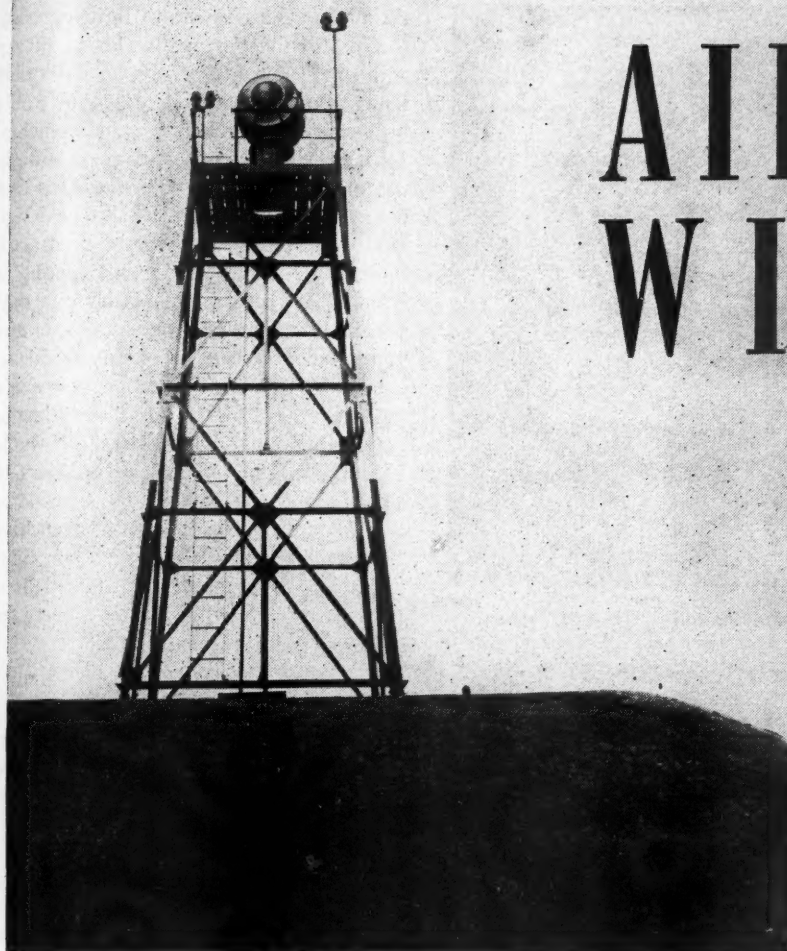
Whether the job is to provide for removal of fumes, dust, heat, or stale air from a single room — or for ventilation of an entire building — you'll find suitable apparatus in the popular Ilg line which Graybar distributes. You'll find, too, that the near-by Graybar Specialist can be of substantial help in planning the ventilating system which will meet your customer's requirements most efficiently and economically.

Other Graybar Specialists — in wiring, lighting, communication, and power apparatus — are always on call to help you plan any type of electrical installation. Though today we may not have in stock *all* the equipment, supplies, and tools you need, there are hundreds of electrical items which our near-by warehouse can deliver immediately. As production increases, we'll be increasingly able to supply everything you want — at a moment's notice. *Graybar Electric Company. Executive offices: Graybar Bldg., New York 17, N. Y. 4645*

IN OVER 90 PRINCIPAL CITIES



Everything for  
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# AIRPORT WIRING

**By Frederick P. Coffey**

*President Anderson-Coffey Company  
Boston, Mass.*

**Wiring and lighting system is installed at Bridgeport Municipal Airport, Stratford, Connecticut by Anderson-Coffey Company without interference to normal airport operations.**

**I**N 1941 invitations to bid on night lighting systems for various airports in the New England area began to be issued. These airports were primarily for the War and Navy Departments. Specifications were issued primarily by the U. S. Engineer Office and were based on ANC (Army-Navy-Civil Aeronautics Authority) standards, modified for each project as required.

While covering electrical work primarily, these jobs were much different than the average electrical job. Not only was wiring for the night lighting systems covered in the specifications, but all excavation and construction connected with the wiring was also included. This included trenching for all underground cable, building of substation, erection of steel work for beacon towers,

building of concrete forms and pouring of concrete.

It was decided the only way to bid on these jobs successfully would be to figure costs on all the work involved—trench and excavation, building and concrete construction, and electrical work. Bids were submitted on this basis, with the result that we were successful bidders on many of these airports, and thus became the prime contractors. Having completed these contracts, much valu-

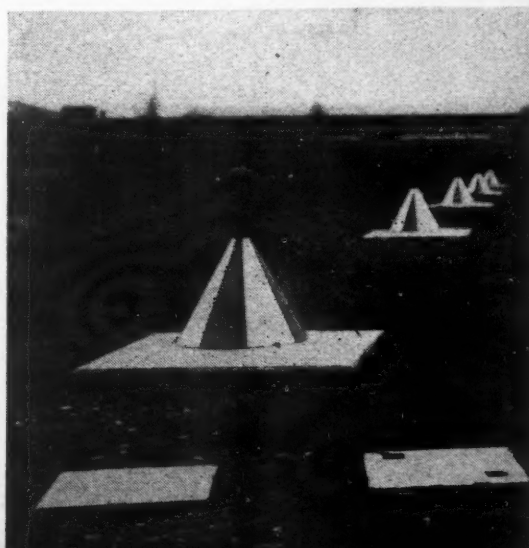
*Cone mounted range lights, of the series circuit "tip-over" type are located across the end of each runway, 100 feet from runway. Cone assembly and wiring details are shown on pg. 72. Cover for isolating transformer of concrete, 4 feet deep, is shown in foreground.*

able experience was gained in this type of work. This experience should be of considerable value for future work of this type, especially in connection with the proposed 3000 small airports recommended by Civil Aeronautics Authority and now before Congress for legislation.

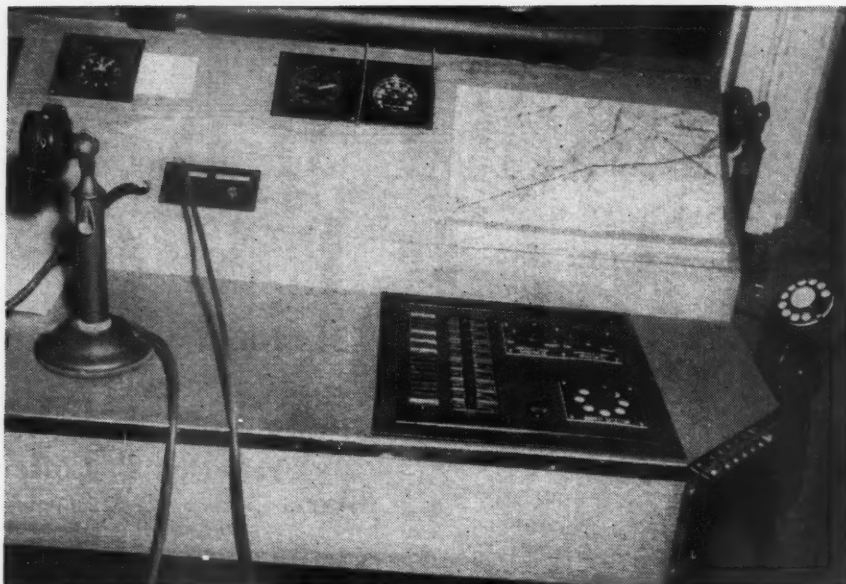
The wiring diagrams, field layout, equipment details, and excavation work on the Bridgeport Municipal Airport, Stratford, Connecticut, used as illustrations with this article, are typical for small airport wiring for night lighting systems. This Bridgeport field was the main testing ground for the Navy Corsair fighter plane, and a great portion of the work had to be done at night in order not to interfere with flight operations. Not over 500 feet of cable trench could be open at any one time. No open excavations for lighting units were permitted outside the area adjacent to the open cable trench. Work could only be performed on one side of a runway at a time. These and similar construction operation restrictions had to be followed on this and other projects.

## **Estimating**

One of the first steps taken by our



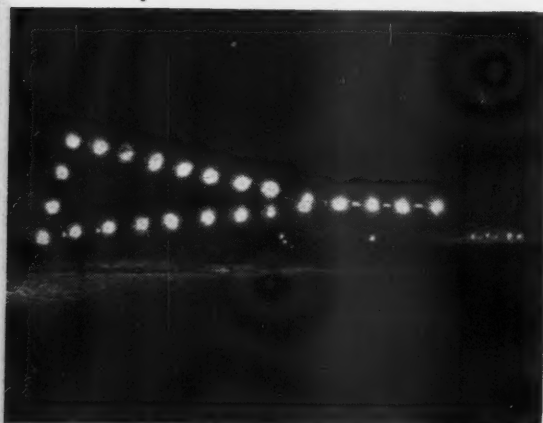




*Control panel for field lighting is located in control tower. Runway selector is in lower right corner of panel, and brightness switches for contact and approach lights immediately above. Breakers and card markers for all circuits are on left of panel.*



*Cable could not be dragged on ground, kinked, or otherwise roughly handled. Truck was used to transport cable reel adjacent to trench, as shown.*



*Daylight view, showing installation of sockets and lamps to outline the tetrahedron. Airport Manager James E. Malarkey stands under one end, to indicate relative size of this day or night wind direction indicator. Inset shows night view with bare colored lamps lighted.*



estimating department in figuring costs for one of these projects was to survey soil conditions at the site to determine what type of trenching machine would be required for digging cable trenches. Most of the airfields had been built in the past few years. We therefore first determined who was the original design engineer, and what general contractor built the airfield. A good insight of what to expect on excavation was then obtained from the design engineer and general contractor. Careful consideration was given as to whether rock would be encountered. If so, the estimator determined what type, whether it would be solid ledge, shale, large boulders or small size rock. This was considered highly important, since cable trenching is one of the large cost items on these projects. Errors in estimating this item can easily mean the difference between a loss or a profit on the job.

#### **Contract Subletting**

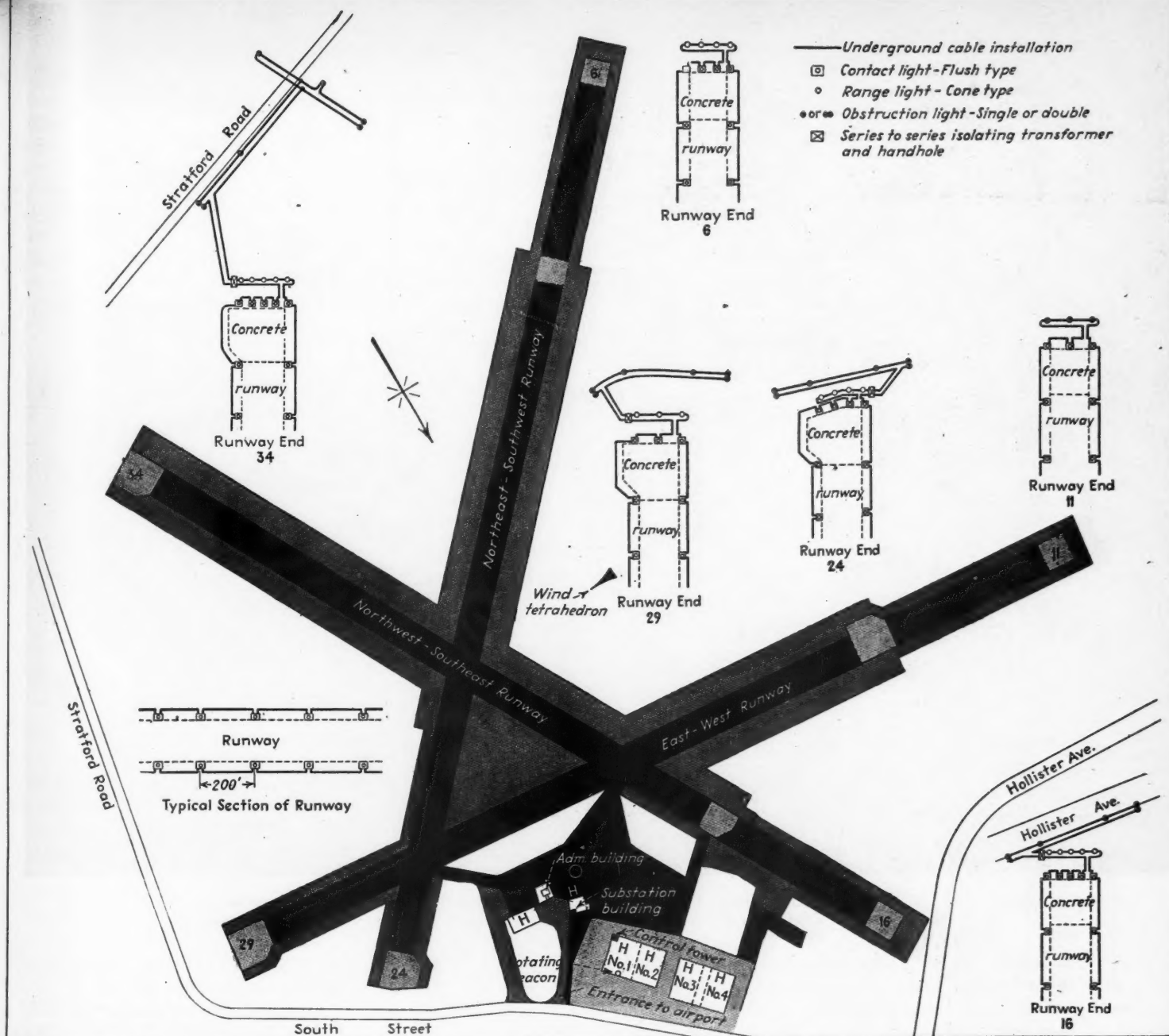
In many instances, work other than electrical construction was sublet to local general contractors, after we had been made prime contractors through successful bidding. If a local general contractor could be found near the site who was interested in excavation work, building of the substation, or all concrete work, he was asked for a bid. If his price came within the limits of our own estimate for the work, a sub-contract would be entered into for that portion of the work. This proved to be unsatisfactory in many cases, as subcontractors in many instances would fall behind working schedules, thereby delaying the installation of our own electrical work.

#### **Highlights of Experiences**

When the Bridgeport Municipal Airport job was begun, considerable trouble was anticipated with respect to restrictions of operations of the contractor. Since this field was the main testing ground for the Navy's Corsair fighter planes, the field was in constant use. Practically no trouble was encountered, however, as the Corsair type of plane is small, requires only a short length of runway to take off and land, and has a short wing spread. Because of the short wing spread, there was considerably less danger to workmen out on the runways of being struck by wing tips.

At the Presque Isle, Maine, Army Transport Command field, much difficulty was experienced from flight operations due chiefly to the large wing spread of the A.T.C. transport planes. Workmen always had to be on the alert to



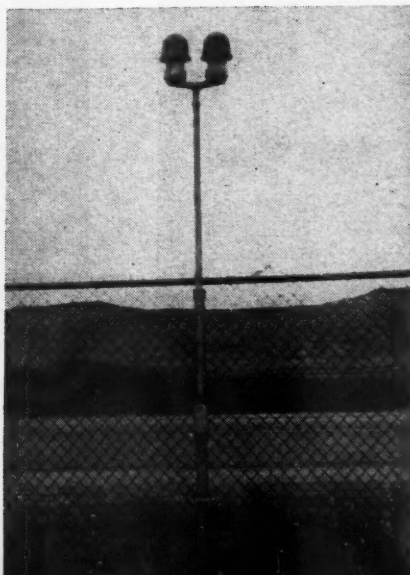
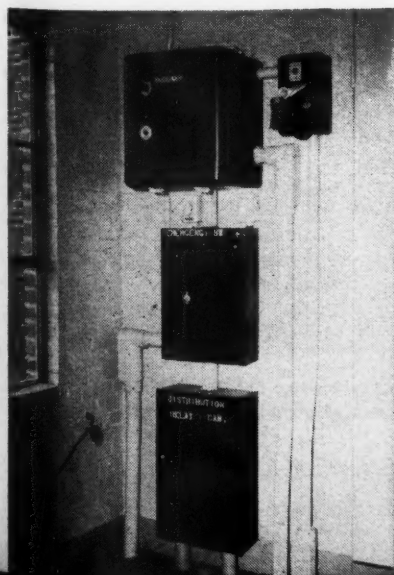


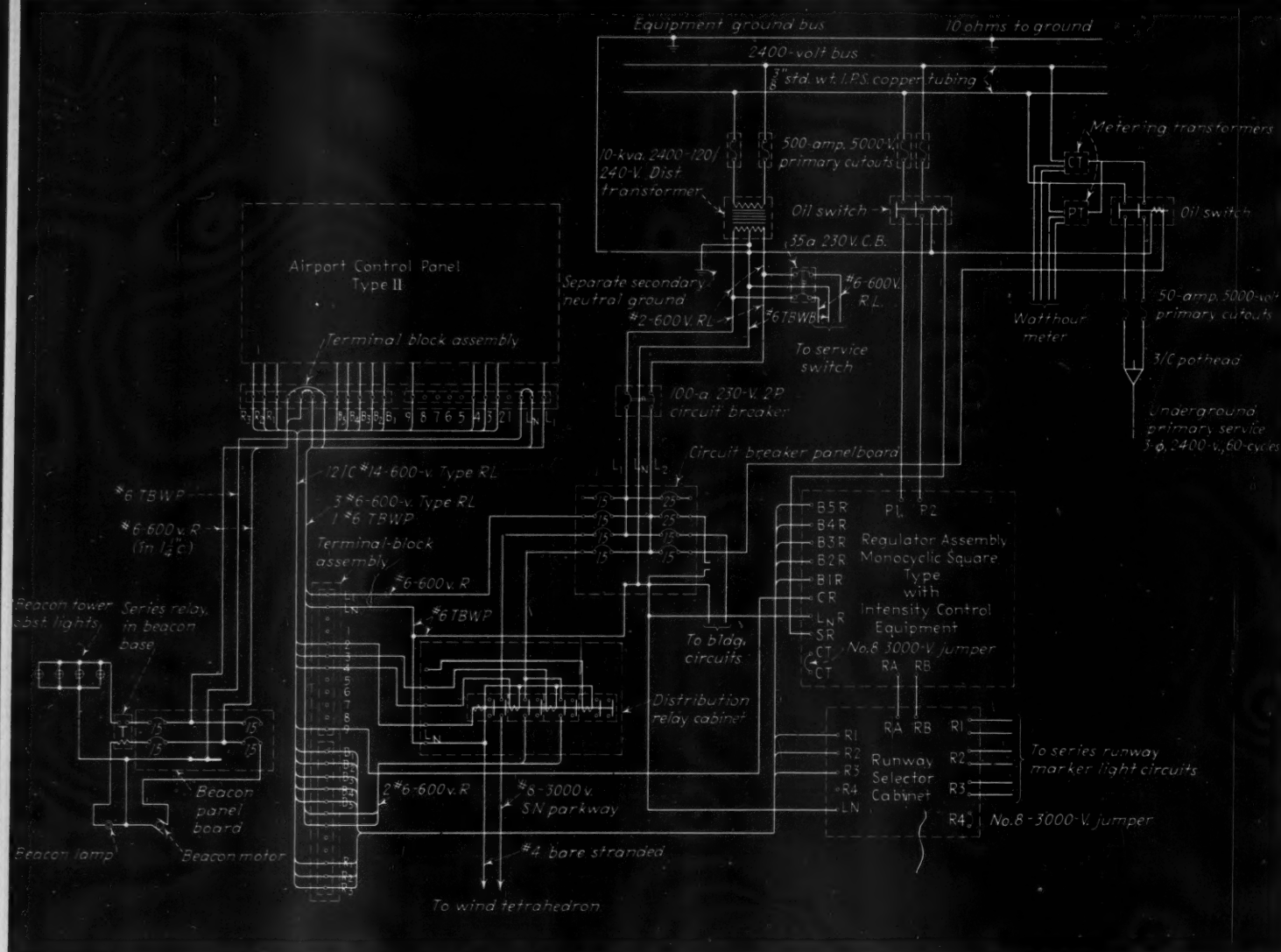
Field layout, showing three runways, hangars, administration building, and location of wind tetrahedron, substation, control tower and beacon tower. Each runway is 5000 feet long. Wiring details for obstruction lights, range lights and flush type runway marker lights at each end of the three runways, and for contact lights on a typical straight section of each runway are indicated.

Contact lights are located on each side of runway on 200-foot centers, and across end of runways. Detail of concrete base is shown on page 73. Marker at right is for protection of unit from snow plow, and consists of upright wood stick painted at top with highly reflective paint. Each marker light base is identified with 4-inch high painted numerals. Base of flush marker lights is grounded.

Control room in substation houses circuit breaker, panelboard and relay cabinet. Wiring details are shown on page 72.

Obstruction lights were installed at end of each runway where roadways exist, and at all points on buildings, poles, towers, etc., which offer hazards.





**Wiring diagram shows wiring layout for entire night lighting system, from primary 3-phase 2400-volt, 60-cycle service to branch circuits feeding field lighting units.**

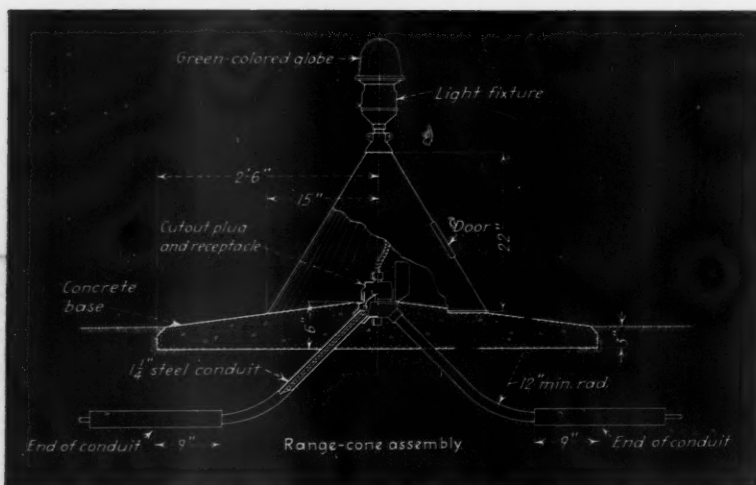
duck the wings while planes were taking off or landing. Back lash from propellers of these large planes also would blow over torches and pitch containers. Soil conditions at this field consisted mainly of large boulders and shale rock. A Parsons type trencher was required to handle this heavy rock material.

At the Navy airfield on the island of Martha's Vineyard, sand or light soil formed the base for the airfield. A Cleveland trencher was used successfully for trench excavating on this job.

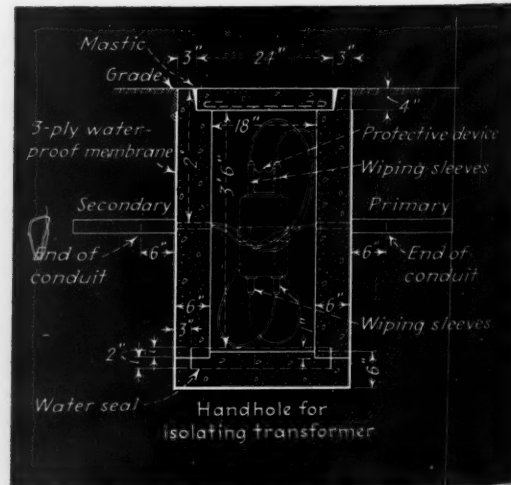
Small boulders were encountered on the Westover field, Army field at Westover, Massachusetts. A Buckeye trench-

er, capable of handling these small boulders, was used for this job.

All cable laying was done from reels mounted on a small half ton pickup truck. All trench backfilling was done with large blade road graders. The large balloon tires of the grader were used to tamp the fill material by run-



**Detail of "tip-over" type range light cone assembly, shown mounted on a concrete base. Method of wiring is also shown.**



**Isolating transformers are installed in concrete bases, with access provided through handhole.**



ning along the top of the trench after the material had been pushed into the trench by the large blade.

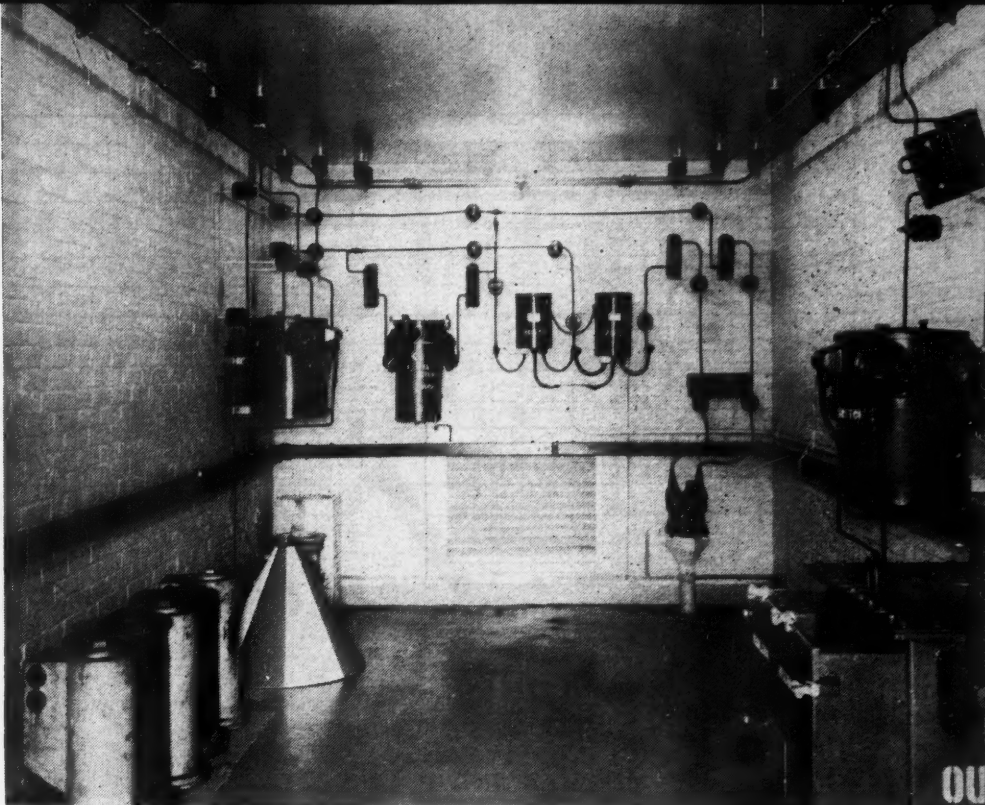
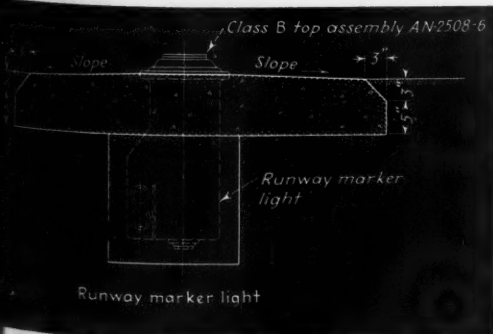
Cable splicers using gasoline torches were bothered by high winds out on the field. The gasoline torches were therefore discarded, and Insto-gas tank type torches were used.

#### Complexity Factor

One of the large cost items involved in the installation of night lighting systems for airports is the complexity factor. Work is spread over a very large area. Considerable time is lost by workmen having to walk long distances from one marker light location to the next one. To overcome this, small pickup trucks were made available to the workmen with instructions to use them as much as possible, rather than walk between these locations.

From our experience with airport wiring for night lighting systems, job costs were easily kept within estimates, with one exception. That exception was where difficult soil conditions were encountered, in connection with trenching and excavation for cable laying. The electrical work in the substation, control tower, and to administration building, hangers, beacon tower, wind tetrahedron, and field lighting units, including obstruction lights, offered no unusual problems. Erection of steel tower for beacon light, either sublet or done by our own workmen, was typical of such construction. Specifications for all work are usually complete in all details, equipment used must be of standard approved designs, conforming to ANC standards, and installation details are clearly set forth in the plans and specifications.

**Detail of runway marker light showing concrete canopy flush with runway and concrete base for cast iron marker light housing. Concrete work was included in electrical contract.**



**Substation and equipment were included in electrical contract. Equipment vault houses primary bus on insulators at ceiling, distribution transformer, runway selector cabinet, regulator assembly, pothead, instrument transformers and switching equipment. Vault is lighted with vaportight ceiling lights.**



**Soil conditions range from sand to boulders, requiring variety of trenching and trucking equipment. Anderson-Coffey Company truck (below, left) hauls cable reel. Cable was laid in trench following trenching machine (right, rear). Road scraper refills trench over cable, and packs dirt in preparation for necessary topsoiling.**





## Part I

**Research and Consulting Engineer**  
**Chicago, Ill.**

**H**ERETOFORE, articles have appeared which were prepared to help answer the customer's question, "How much will it cost?" This and following articles are designed to assist in answering some of the contractors' queries on "How much will it cost me to do a job?"

A very common question posed by the contractors is, "How much overhead should be added to electrical work?" There is no intelligent answer for such a question. If one were asked a similar question about a particular job, with which he was sufficiently acquainted, he might be able to give an intelligent answer. If the amount given were correct, it would be applicable only to a contractor who was organized and equipped to properly do the work.

tion without having any clear idea as to just what constitutes overhead. Any percentages given would mean little unless it was understood just what expenses were to be covered by them.

In supplying electrical installations, the contractor has three major divisions of cost to consider, namely:

1. Base cost (Material — purchase price; and direct labor)
2. Direct job costs
3. Overhead

**FIG. 1—Items of operating costs showing which are chargeable to direct jobs costs and to general overhead. Note material service and labor burden headings under direct job costs.**

## NOTES

1—Percentages compiled from surveys of comp. install. work, incl. all material.  
2—Cois. to be filled in with figures suitable to the project being estimated.

3—See table on "oper. costs—sheet 1." for div. of gen. OH. & admin. costs.

4—Materials & equipment, purchased by owner, may not be delivered as per expediting costs and causes loss of labor due to delays and labor disruptions.

# DIVISION OF OPERATING COSTS FOR ELECTRICAL INSTALLATIONS SHOWN IN PERCENTAGE OF COSTS OF MATERIAL AND LABOR

LABOR RATE 1.50 PER HR.

ITEMS OF EXPENSE	INDUSTRIAL WORK										COMMERCIAL WORK										ALTERATIONS—COMMERCIAL											
	LABOR & MATERIAL FUR. BY CONTR.					INSTALLATION ONLY PROJ. <sup>⑤</sup>					LAB. & MAT.					LAB. & MATERIAL BY CONTR.					LAB. & MATERIAL BY CONTR.											
	JOB REQ. 5 TO 25 ELECT.	ENG. BY OTHERS	CONTR.	ENG. BY OTHERS	CONTR.	JOB REQ. 25 TO 50 ELECT.	ENG. BY OTHERS	CONTR.	ENG. BY OTHERS	CONTR.	5 TO 25 ELECT.	5 TO 25 ELECT.	5 TO 25 ELECT.	5 TO 25 ELECT.	5 TO 25 ELECT.	JOB REQ 5 TO 25 ELECT.	ENG BY OTHERS	CONTR.	ENG BY OTHERS	CONTR.	JOB REQ 5 TO 25 ELECT.	ENG BY OTHERS	CONTR.	ENG BY OTHERS	CONTR.	JOB REQ 5 TO 25 ELECT.	ENG BY OTHERS	CONTR.				
NOTE:— THE FIGURES IN THESE TABLES ARE BASED ON RELIABLE SURVEYS. SEE LIST BELOW. ①	APPROX. SEE NOTE 3	MIN.	MAX.	APPROX. SEE NOTE 3	MIN.	MAX.	APPROX. SEE NOTE 3	MIN.	MAX.	APPROX. SEE NOTE 3	MIN.	MAX.	APPROX. SEE NOTE 3	MIN.	MAX.	APPROX. SEE NOTE 3	MIN.	MAX.	APPROX. SEE NOTE 3	MIN.	MAX.	APPROX. SEE NOTE 3	MIN.	MAX.	APPROX. SEE NOTE 3	MIN.	MAX.	APPROX. SEE NOTE 3	MIN.	MAX.		
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
ENGINEERING & LAYOUT	—	—	—	5.00	7.00	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
SELECTING & PURCHASING	1.00	1.50	—	0.75	1.00	—	0.75	1.25	—	0.50	0.75	—	0.50	1.00	—	0.40	0.80	—	0.50	1.50	—	1.00	2.00	—	0.75	1.50	—	0.50	1.50	—	0.50	1.50
FOLLOW UP & COORD. DELIVERY	0.50	1.00	—	0.30	0.50	—	0.40	0.80	—	0.25	0.40	—	0.10	0.80	—	0.10	0.20	—	0.50	1.00	—	0.50	1.50	—	0.50	1.00	—	0.50	1.00	—	0.50	0.75
CARTAGE & SPECIAL DELIVERY	—	0.25	—	—	—	—	—	0.15	—	—	—	—	—	—	—	—	—	—	0.50	1.50	—	0.25	1.00	—	—	—	—	—	—	—	—	—
STORAGE FACILITIES (FIELD)	0.04	0.50	—	0.04	0.50	—	0.02	0.40	—	0.02	0.40	—	—	—	—	—	—	—	0.04	0.50	—	0.04	0.10	—	—	—	—	—	—	—	—	—
GEN. OVERHEAD & ADMIN. EXP.	5.65	10.58	—	5.65	10.58	—	4.80	8.80	—	4.80	8.80	—	2.56	4.24	—	1.82	3.41	—	8.50	12.70	—	2.72	5.07	—	8.50	12.80	—	8.50	12.80	—	8.41	8.43
TOTALS	7.19	13.63	—	11.74	19.65	—	9.72	11.10	—	10.07	17.00	—	2.80	5.74	—	2.32	4.61	—	8.94	17.20	—	3.42	6.72	—	10.94	20.30	—	16.04	28.40	—	4.41	8.68
II COST OF SUPPLYING LABOR																																
SUPERVISION	2.50	3.20	—	2.34	2.98	—	2.44	2.86	—	2.20	2.60	—	2.80	3.80	—	2.52	3.42	—	2.86	3.52	—	3.20	3.88	—	3.60	4.50	—	3.60	4.50	—	5.00	6.25
TOOLS—CONSUMED & DEPR.	3.50	5.70	—	3.50	5.70	—	3.00	4.00	—	3.00	4.00	—	3.50	5.70	—	3.00	4.00	—	3.50	5.70	—	3.50	5.70	—	3.00	4.60	—	3.00	4.60	—	3.00	4.60
FIELD SHOP TOOLS	—	0.12	—	—	—	—	—	0.10	—	—	—	—	—	0.12	—	—	—	—	—	0.12	—	—	—	—	—	0.15	—	—	0.15	—	—	0.30
CARTAGE (TOOLS)	0.10	0.20	—	0.10	0.20	—	0.10	0.15	—	0.10	0.15	—	0.20	0.30	—	0.20	0.25	—	0.15	0.20	—	0.25	0.30	—	0.35	0.45	—	0.35	0.45	—	0.40	0.80
FIELD OFFICE & SHOP BLDG.	—	0.50	—	—	—	—	—	0.30	—	—	—	—	—	—	—	—	—	—	—	0.50	—	—	—	—	—	—	0.17	—	—	—	—	0.20
ENG. LAYOUT & STUDY TIME	—	—	—	5.00	7.00	—	—	—	—	5.00	7.00	—	2.00	4.00	—	2.00	4.00	—	1.00	2.00	—	3.00	5.00	—	1.00	2.00	—	6.00	8.00	—	3.00	5.00
FIELD ENGINEERING	3.20	6.40	—	2.40	4.80	—	3.20	6.40	—	2.40	4.80	—	2.40	4.80	—	2.40	4.80	—	3.20	6.40	—	4.00	8.00	—	4.00	8.00	—	3.50	6.40	—	4.80	9.60
FIELD TELEPHONE	—	0.14	—	—	—	—	—	0.14	—	—	—	—	—	—	—	—	—	—	—	0.20	—	—	—	—	—	—	0.40	—	—	—	—	0.50
BLUE PRINTING & JOB STATIONARY	0.08	0.12	—	0.08	0.12	—	0.08	0.12	—	0.08	0.12	—	0.30	0.50	—	0.30	0.50	—	0.10	0.15	—	0.20	0.30	—	0.40	1.00	—	0.40	1.00	—	0.50	1.00
TRAVEL EXP—OFFICE TO JOB	0.15	0.35	—	0.15	0.35	—	0.10	0.25	—	0.10	0.25	—	0.30	0.50	—	0.15	0.25	—	0.25	0.35	—	0.35	0.50	—	0.50	0.60	—	0.50	0.60	—	0.60	0.70
GEN. OVERHEAD & ADMIN. EXP.	14.88	21.20	—	14.16	20.00	—	12.00	17.00	—	11.30	16.00	—	18.50	26.40	—	15.00	21.20	—	16.50	23.20	—	18.00	25.50	—	22.40	31.80	—	22.40	31.80	—	28.00	39.60
TOTALS	24.49	37.93	—	23.73	41.81	—	20.92	31.34	—	24.19	35.46	—	30.00	46.06	—	25.37	38.95	—	27.56	42.34	—	35.50	50.10	—	35.65	54.17	—	39.60	57.62	—	45.50	68.45
LABOR ONLY JOBS—ADD EXP. OF CHKS. MAT. & COORD. DEL.—1.5% (MAT. & DEL.)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
TOTALS—NOT INCL. INS.	24.49	37.93	—	23.73	41.81	—	20.92	31.34	—	24.19	35.46	—	34.29	50.02	—	29.09	45.06	—	27.56	42.34	—	37.63	50.10	—	35.65	54.17	—	39.60	57.62	—	45.50	68.45
INSURANCES	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
TOTALS	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

NOTES—  
 ① THE FIGURES IN THESE TABLES ARE BASED ON SURVEYS AND STUDIES MADE BY THE FOLLOWING:  
 DUN AND BRADSTREET — 1934  
 DUN AND BRADSTREET — 1935  
 NATL. ELECT. CONTRS. ASSN. — 1937  
 ELECT. CONTRS. ASSN. OF PITTSBURG — 1938  
 (SURVEY BY A. H. BLASE CO., AUDITORS)  
 ELECT. CONTRS. ASSN. OF CHICAGO — 1939  
 ELECT. CONTRS. ASSN. OF CHICAGO — 1940  
 ② CONTRACTING (ELECT.) IS A SERVICE TRADE WITH THE SUPPLYING & MANAGEMENT OF LABOR AS THE PRIMARY FUNCTION. MATERIAL IS INCIDENTAL AND REGARDLESS OF WHO PURCHASES IT, THE CONTRACTOR ASSUMES RESPONSIBILITY IN CONNECTION WITH THE PROPER SELECTION, DELIVERY, STORAGE, INSTALLATION, AND OPERATION.  
 ③ COMPENSATION MUST BE COMMENSURABLE TO SERVICES RENDERED.  
 ④ FILL IN VACANT COL. WITH PERCENTAGES TO FIT THE PARTICULAR JOB BEING CONTEMPLATED.  
 ⑤ IT IS ASSUMED THAT THE COST OF MATERIAL WILL BE 30% GREATER THAN THE COST OF LABOR, OR THAT 1% OF MAT. COST IS EQUAL TO 1.5% OF LAB. COST. FOR LABOR ONLY PROJECTS, 1.5 TIMES THE PERCENTAGE SHOWN UNDER MAT. HANDLING (ITEM I) MUST BE ADDED TO LABOR (ITEM II).  
 ⑥ INSTALLATION ONLY PROJECTS ARE OFTEN ERRONEOUSLY REFERRED TO AS "LABOR ONLY JOBS."

FIG. 2—Division of operating costs for electrical installations showing how costs vary with type and size of job.



TABLE I  
ESTIMATED COST OF TOOLS  
To Equip a Job Requiring a Crew of Fifty Electricians

Item	Remarks	No. in Use	Purchase Price Each	Total Cost the Lot	Depreciation and Int. on Invest. Per Mo. Each		Estimated Repairs Per Mo. Each	Total Cost Per Month	
					Percent	Dollars		Each	The Lot
Elec. Drills	1/4 in.	4	\$31.00	\$124.00	5.5	\$1.75	\$ .25	\$2.00	\$8.00
Elec. Drills	1/2 in.	2	57.00	114.00	5.5	3.14	.30	3.44	6.88
Step Ladders	8 Ft.	6	10.00	60.00	20	2.00	—	2.00	12.00
Step Ladders	12 Ft.	8	15.00	120.00	26	3.90	.25	4.15	33.20
Step Ladders	14 Ft.	8	17.50	140.00	30	5.25	.25	5.50	44.00
Extens. Ladders	32 Ft.	1	15.00	15.00	10	1.50	—	1.50	1.50
Pipe Benches	Small	5	9.00	45.00	4	.36	—	.36	1.80
Pipe Benches	Large	5	15.00	75.00	6	.90	—	.90	4.50
Pipe Vise	1/2" to 2"	5	3.00	15.00	4	.12	.25	.37	1.85
Pipe Vise	2" to 3 1/2"	5	5.00	25.00	4	.20	.50	.70	3.50
Stocks	1/4"-3/4"-1"	6	6.00	36.00	10	.60	—	.60	3.60
Stocks	1 1/4"-2"	6	12.00	72.00	10	1.20	—	1.20	7.20
Stocks	2"-Ratchet	3	17.00	51.00	10	1.70	.15	1.85	5.55
Stocks	2 1/2"-4"	3	50.00	150.00	5	2.50	1.00	3.50	10.50
Thread Cutter	Power Driven	2	290.00	580.00	5	14.50	4.00	18.50	37.00
Pipe Dies	1/4" & 1/2"	10	1.95	19.50	60	1.17	—	1.17	11.70
Pipe Dies	1" & 1 1/4"	6	2.80	16.80	60	1.68	—	1.68	10.08
Pipe Dies	2"	4	3.50	14.00	40	1.40	—	1.40	5.60
Pipe Dies	2 1/2"	4	7.00	28.00	25	1.75	—	1.75	7.00
Pipe Dies	3"	2	7.00	14.00	25	1.75	—	1.75	3.50
Pipe Dies	4"	1	8.00	8.00	20	1.60	—	1.60	1.60
Hickies	1/2" to 1"	15	2.00	30.00	10	.20	—	.20	3.00
Pipe Benders	Small	2	145.00	290.00	5	7.25	1.25	8.50	17.00
Pipe Benders	Large	1	300.00	300.00	5	15.00	2.00	17.00	17.00
Tool Boxes	Wood	6	20.00	120.00	10	2.00	.30	2.30	13.80
Tool Boxes	Steel	6	20.00	120.00	4	.80	—	.80	4.80
Winches	Hand Drive	2	65.00	130.00	5	3.25	1.00	4.25	8.50
Winches	Power Drive	2	90.00	180.00	5	4.50	2.00	6.50	13.00
Jacks	Stone	2	85.00	170.00	4	3.40	—	3.40	6.80
Reel Jacks		12	22.00	264.00	4	.88	.25	1.13	13.56
Fish Tape	1/4"-100'	6	1.70	10.20	50	.85	—	.85	5.10
Fish Tape	3/8"-100'	4	2.13	8.52	50	1.07	—	1.07	4.28
Fish Tape	1/2"-200'	2	2.60	5.20	25	.65	—	.65	1.30
Blocks	Snatch & Misc.	6	8.00	48.00	5	.40	—	.40	2.40
Rope Hemp	1/2"-200'	2	5.00	10.00	30	1.50	—	1.50	3.00
Rope Hemp	3/4"-200'	2	8.00	16.00	30	2.40	—	2.40	4.80
Rope Wire	1/2"-150'	2	18.00	36.00	8	1.44	—	1.44	2.88
Rope Wire	3/4"-100'	2	40.00	80.00	8	3.20	—	3.20	6.40
Chain Hoist	1 to 5 Ton—10' Lift	1	135.00	135.00	3	4.05	—	4.05	4.05
Wagon Trucks		2	30.00	60.00	8	2.40	.50	2.90	5.80
Whitney Punches & Dies	Miscellaneous	4	60.00	240.00	2	1.20	2.00	3.20	12.80
Extens. Cords	Heavy Duty—Compl. with Socket—50 ft. cord	16	4.00	64.00	10	.40	.50	.90	14.40
Gas Furnaces	Plumbers	2	12.25	24.50	4	.49	—	.49	.98
Gas Tanks & Burners	Compressed Gas	4	35.00	140.00	4	1.40	—	1.40	5.60
K. O. Punches		4	7.50	30.00	20	1.50	—	1.50	6.00
Pipe Wrenches	18"	10	3.00	30.00	10	.30	—	.30	3.00
Pipe Wrenches	24"	8	5.00	40.00	10	.50	—	.50	4.00
Chain Tongs	Miscellaneous	3	Av. 9.00	27.00	10	.90	—	.90	2.70
Cable Pullers	"Come Along"	6	6.00	36.00	50	3.00	—	3.00	18.00
Scaffolding	Miscellaneous	—	120.00	120.00	10	12.00	—	12.00	12.00
Star Drills		20	Av. .50	10.00	20	.10	.15	.25	5.00
Reamers	Misc.—Ratchet	6	5.00	30.00	10	.50	.25	.75	3.00
Files	Miscellaneous	50	.30	15.00	50	.15	—	.15	7.50
Twist Drills	Miscellaneous	80	.20	16.00	25	.05	—	.05	4.00
Taps	Miscellaneous	50	.20	10.00	60	.12	—	.12	6.00
Oilers		20	.25	5.00	33	.08	—	.08	1.60
Hammers & Sledges	Miscellaneous	6	Av. 2.00	12.00	10	.20	.25	.45	2.70
Bull Pts.	Miscellaneous	6	1.00	6.00	10	.10	.20	.30	1.80
Shovels	Miscellaneous	3	1.50	4.50	10	.15	—	.15	.45
Locks & Chains		20	2.00	40.00	8	.16	—	.16	3.20
Hack. Blades		300	.06	18.00	100	.06	—	.06	18.00
				\$4,653.12				\$490.76	
				Plus 2% for waste, small tools and misc. shop supplies					9.81
									\$500.57

FIG. 3—Estimated cost of tools required to equip a fairly large electrical job. Expenses such as these are direct job costs chargeable to labor burden (See Fig. 1).

Direct Job Costs are items of expense which can be established as a direct cost of a particular project. (See Fig. 1 for listings)

Overhead embraces such items of expense as cannot be identified with any particular job.

The combined expenses for direct job costs and overhead constitutes the Operating Costs.

Fig. 1 shows the divisions of operating cost which are experienced on the ordinary run of electrical installations. As we study overhead we shall see that it is rather flexible. It goes up and down with the type of installations, working conditions, etc. On special projects of the larger sizes, items of expense

ordinarily included in overhead, such as bookkeeping and other office expenses, may be partially charged off as direct job costs.

For reasons which will become obvious as we go along, the items listed as direct job costs in Figure 1 should be charged as such and not included in overhead. A difference of opinion exists among contractors as to where the charges for such items as engineering and tools belong. Why should there be? Both items are subject to fluctuation with the type and size of project. If a contractor is going to figure against competition, and select the more desirable jobs, he must get such charges where they belong.

For example, let us assume that a

contractor has two jobs of the same volume. One may be of a complicated nature with poorly engineered plans; the other simple in nature with plans completely laid out and engineered. The contractor spends \$600 on the first job for engineering and drafting and only \$200 on the second. The average is \$400.

If this cost had been included in a common overhead, both jobs would have been charged \$400. The more desirable job would be penalized \$200, and the poorer job would be given the benefit of this \$200 overcharge.

Such costs have to be estimated, as well as labor, and estimators can figure them accurately enough for all practical purposes.

Tools are an item of labor expense and therefore should be charged as a direct job cost of labor. If this is not done, operating costs for installation only projects will be greatly underestimated.

Numerous reasons can be cited for keeping every item, which can be established as a direct job cost, out of overhead. It is easier to sell direct job costs than it is to sell overhead. It is also easier to settle "cost plus" contracts if charges are properly set up.

Some readers may recall the "messages" of Robert McChesney, president of the National Electrical Contractors' Association, which appeared in the April and June, 1941 issues of "Qualified Contractor." In these "messages" Mr. McChesney warned the members of the necessity of charging direct job costs where they belonged. Contractors who later had renegotiation experience with the government, appreciated the justification of such a warning. Numerous cases of renegotiation were brought to the writer's attention and in every case where direct job costs were not properly charged off, the contractor had trouble getting an equitable settlement.

#### Explain Operating Costs

The importance of thoroughly understanding operating costs is not limited to being able to establish markups. One must be able to intelligently explain them to customers. Much emphasis has been put on this phase of the business by the National Electrical Contractors Association. In 1936, 1937, and subsequent years, NECA published valuable data compiled from surveys. Reports on such surveys aid contractors in establishing their own operating costs, as well as in being able to explain them.

In studying any published survey data, it must be borne in mind that such

[Continued on page 203]

# Impact of Wage-Price Policy

Prices of electrical materials are affected by the new wage-price policy. Survey of manufacturers show price increases of 15 percent or more are necessary.

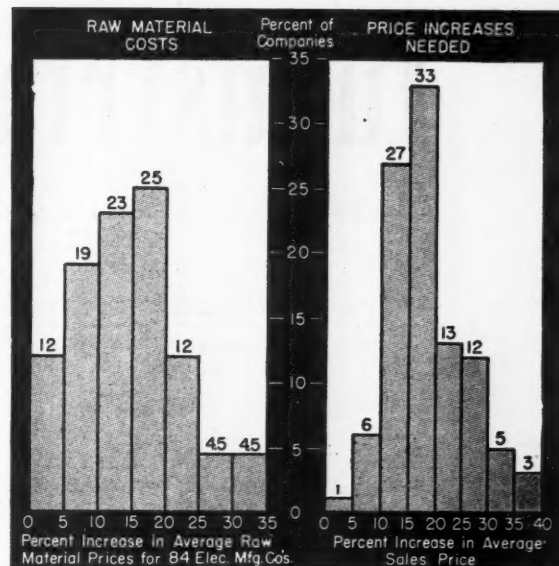
**ELECTRICAL CONTRACTING** asked a representative group of producers of electrical goods how the new wage-price policy will affect them. Answers vary widely, but in many respects there is significant agreement among the 87 companies whose replies are summarized below.

1. *Increased prices are essential.* Every company but one (and it already had raised prices 13 percent) reported that higher costs make necessary an advance in prices. Estimates range from 5 to 40 percent, with almost two-thirds of the manufacturers stating an increase of more than 15 percent will be required and most of the remaining third needing a 10 to 15 percent advance.
2. *About two-thirds of the companies have not changed prices since January, 1941.* Of the other third, a few report advances up to 18 percent but most show an increase around 10 percent.
3. *While prices remained unchanged, labor costs of half the companies rose in excess of 50 percent and raw material costs increased 15 percent or more.* As shown in the chart and tables, the rise in labor

costs has differed greatly from company to company. However, few companies have failed to advance straight-time hourly wage rates more than the increase in the cost of living since January 1941.

4. *About half the companies report labor is now receiving higher average straight-time hourly earnings than at V-J Day.* But in most instances, the increase falls far short of 18 percent.
5. *If wage rates were to be boosted 18 percent above V-J Day, about half the electrical manufacturers would be required to grant an additional 15 to 20 cents an hour.* But for many small companies whose prewar wage rate was lower than average, 15 to 20 cents would represent a boost of much more than 18 percent.
6. *All producers agree raw material prices will rise—10 to 15 percent is a typical estimate.* This will be piled on top of increases of equal magnitude that have occurred since January 1941.

Higher wages are at the bottom of increased costs. Although straight-time hourly wage rates from January 1941



to V-J Day were increased only 15 percent by the "little steel" formula, average straight-time hourly earnings were permitted to climb in most industries by an amount equal to or greater than the 33 percent advance in the cost of living. Upgrading, new vacation pay, and other "fringe" increases brought about this rise in average straight-time hourly earnings.

Since V-J Day national wage policy has sought actively to increase straight-time hourly earnings to compensate for possible decreased take-home pay resulting from the shorter work week,

(Continued on page 198)

**TABLE 1**

Increase in Average Sales Price Required Where Prices Have Not Been Increased Since January 1941.

(Reported by 51 Electrical Manufacturing Companies)

% Increase in Average Str. Time Hrlly. Earnings Since Jan. 1941 if They are Raised 18% Above V-J Day	Number of Companies Reporting This Increase	% Increase in Cost of Raw Materials Since Jan. 1941	Further % Increase Expected in Cost of Raw Materials	% Increase in Average Sales Price Necessary Under New Wage-Price Policy
Above 110%	3	3-4%	5-12%	8-15%
100-110	1	12.2	10-15	18
90-100	4	3-33.3	5-10	16-33.3
80-90	7	7-24	7.5-20.0	10-25
70-80	9	5-26	10-20	12-38
60-70	16	0-34	10-20	5-30
50-60	6	4-31.1	10-23	3-20
40-50	3	5-20	15-20	8-20
30-40	2	3-5	10-18	10

**TABLE 2**

Increase in Average Sales Price Required Where Sales Price Has Been Advanced Since January 1941.

(Reported by 36 Electrical Manufacturing Companies)

% Increase in Average Str. Time Hrlly. Earnings Since Jan. 1941 if They are Raised 18% Above V-J Day	Number of Companies Reporting This Increase	% Increase in Cost of Raw Materials Since Jan. 1941	Further % Increase Expected in Cost of Raw Materials	% Increase in Average Sales Price Since Jan. 1941	Additional % Increase in Sales Price Necessary
Above 110%	0				
100-110	3	0-29.8%	7-10%	10-13.3%	0-35%
90-100	4	5-26	10-25	5-18	8.5-36
80-90	2	4.5	10-25	10-12.5	15-18
70-80	5	10-33	8-15	1.8-10	10-15
60-70	11	7-20	10-20	0.7-24	5-40
50-60	5	3-11	10-15	3-12.5	15-30
40-50	5	6-30	10-20	6-15	14-25
30-40	1	20		10	10



# Grounding Industrial Power Systems

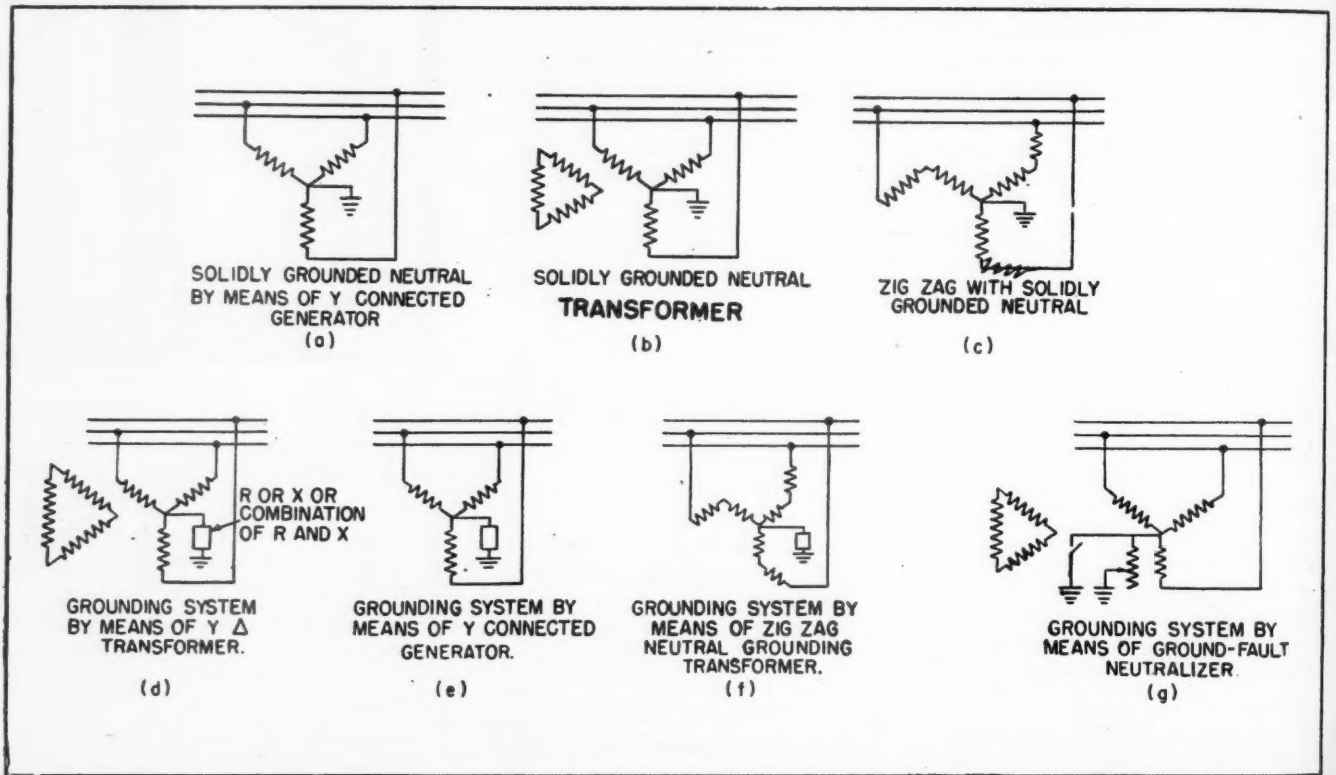


FIG. 1—Common methods of neutral grounding where ground fault current is limited only by inherent impedance of grounded apparatus and impedance of ground fault current path, a, b, c, where ground fault current is further limited by means of neutral impedance, d, c, f, g.

IT is surprising that the innocent term "Grounding," as applied to electric circuits and equipment, has so many complex ramifications. One need only glance at the literature to realize that a tremendous amount of thought has been given to this subject, and that much remains to be done. To accomplish anything in a short discussion, it is necessary to focus attention on a small part of the subject.

A review of the electrical system grounding practice in industrial plants today would probably show that the majority of existing systems operating at 4160 volts and above are grounded in some manner, while the majority of those in the voltage class of 2300 volts and below are operating ungrounded.

In new plants, grounding the neutral in these lower voltage systems is becom-

ing more common. Operators with ungrounded neutral systems are running into operating and maintenance problems which can be minimized by neutral grounding, and are beginning to inquire how they can ground their systems to avoid some of the difficulties encountered with ungrounded systems.

Effective grounding of any circuit or equipment requires a suitably low impedance ground. Sometimes it is difficult to achieve such a low value of ground impedance. Consideration of the ways and means of making such grounds has been given extensive treatment in literature on the subject.

For the present purposes, it will be assumed that an adequate ground connection is available, and we will confine our attention to illustrating some of the reasons for grounding and some of

the problems which arise in circuits where the ground system has not been properly designed.

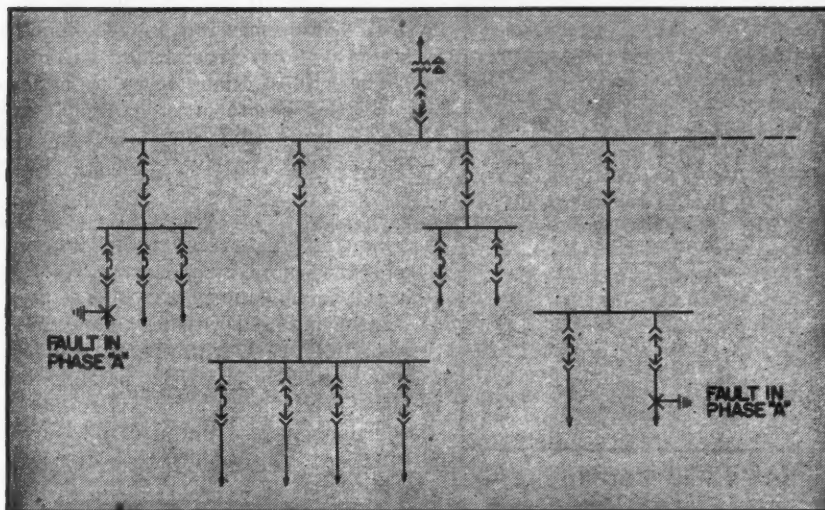
Sometimes ground systems are not given the attention necessary to insure proper and safe operation. In general, the ground circuits should be engineered with as much care as the main power circuits to insure proper performance.

Effective grounding is defined by the National Electrical Code as follows: "The path to ground from circuit, equipment, or conductor enclosure shall be permanent and continuous and shall have ample carrying capacity to conduct safely any current liable to be imposed on it, and shall have an impedance sufficiently low to limit the potential above ground and to facilitate the operation of the overcurrent devices in the circuit."

**Grounding of industrial plant distribution systems insure safe operation. This article reviews current practice and problems.**

**By L. G. Levoy, Jr.**

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General Electric Co.  
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**FIG. 2—Location of ground faults may be troublesome in ungrounded circuits.**

The American Standard Association definition, (35.15.205) for "effectively grounded" states that "effectively grounded means grounded through a ground connection of sufficiently low impedance (inherent and/or intentionally added) that fault grounds which may occur cannot build up voltages dangerous to connected equipment."

Figure 1 shows various common methods of system neutral grounding. It will be noted that all of these methods require the establishment of a system neutral and its connection to ground, either directly or through a suitable current limiting impedance.

Systems rated 600 volts and below, when grounded, the neutrals are usually connected directly to ground without

any current limiting impedance, since in such systems the impedance of the ground path usually limits the current sufficiently. Furthermore, the maximum possible voltage which can appear across any portion of the ground path is low, for example, 277 volts in the case of a 480 volt system.

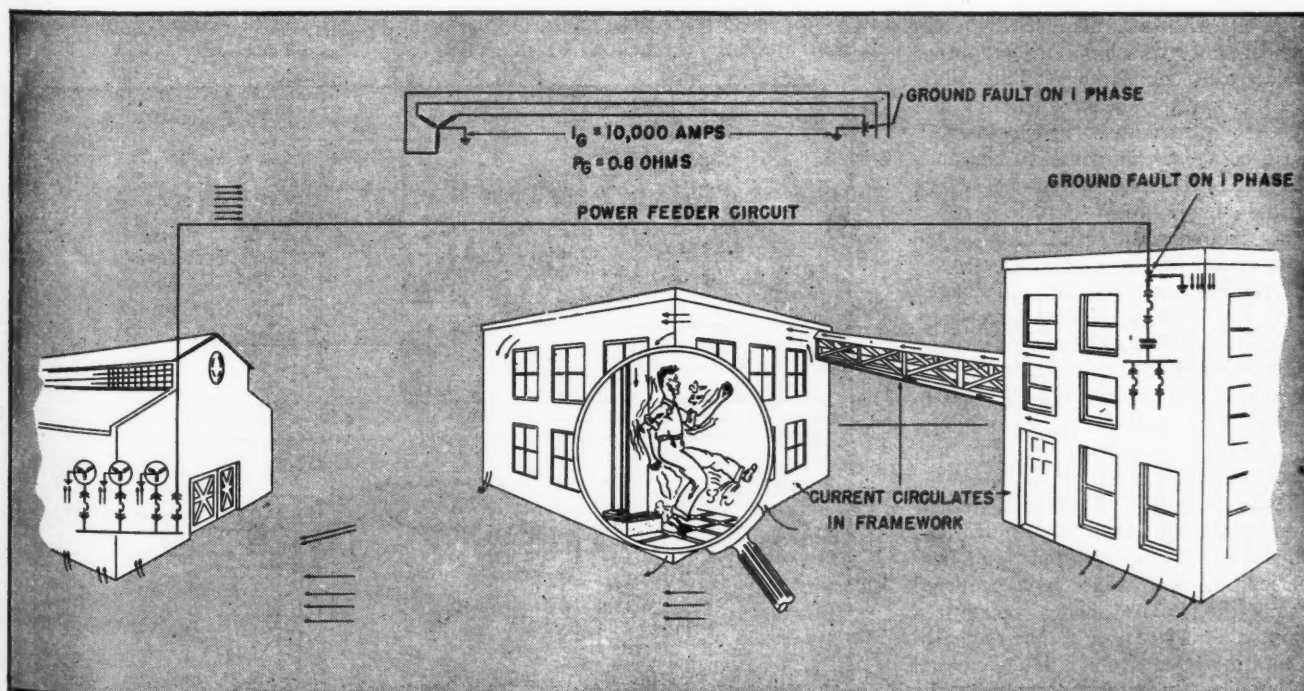
For higher voltage systems, it is common to limit the current either by means of a resistance or reactance (or a combination of both) in the neutral, unless the inherent impedance of the system limits the ground fault current to sufficiently low levels that the equipment can withstand it, in which case the system may be "solidly grounded."

A neutral grounding transformer is used for cases where the system neu-

tral cannot otherwise be effectively grounded.

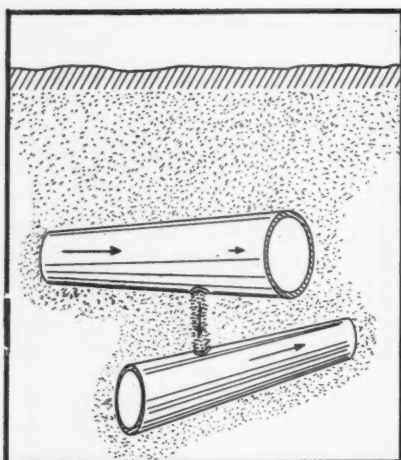
The ground fault neutralizer is most commonly used in higher voltage systems (13.8 kv. and above) using overhead transmission lines in order to provide for possible self-clearing of ground faults.

Figure 2 shows types of ground faults in an ungrounded system which cannot be located by de-energizing one circuit at a time. These faults may be in the feeders or in the connected load machines. Location of faults of this type require shutting down the whole bus section and starting up one circuit at a time, until the faulted circuits are located. Should the faults be on different phases, a line to line fault results, and

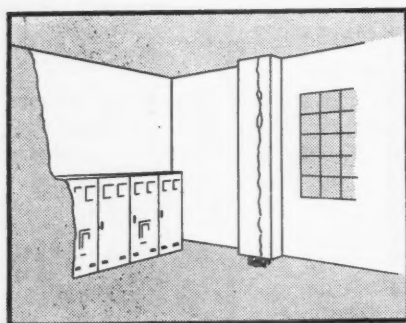


**FIG. 3—Possible personnel hazard due to large ground fault currents.**





**FIG. 4—Leaking underground gas, water or air pipes caused by large stray ground fault currents.**



**FIG. 5—Structural damage caused by large ground fault currents in members not designed to carry such currents.**

the high currents involved may seriously damage both circuits or machines. Such a condition results in loss of service on two feeders.

Figure 3 shows a man receiving an electrical shock in a building containing no electrical connections. This illustrates the need for adequate bonding and grounding of structures in cases where large ground fault currents are possible. Note that in this case dangerously large potentials may appear across portions of the ground path, especially in the neighborhood of the ground electrodes. The remedy here is to adequately ground the building containing electric equipment and to limit the ground fault currents to reasonable levels. Also note that if the column was bonded to the steel floor in the adjacent building, no difference of potential could exist between columns and floor.

Figure 4 shows a case of underground pipes which were caused to leak each time a heavy ground fault was experienced. Such cases have occurred without their cause being recognized promptly. This situation can be remedied by limiting the ground fault current and bonding the piping systems.

Figure 5 shows a cracking concrete

column due to the overheating of a steel reinforcing rod in the concrete caused by stray ground fault current.

These illustrations serve to indicate the varied nature of ground fault current damage and show some of the reasons for careful ground system design.

An important reason for limiting ground fault current is to minimize cable and apparatus damage resulting from ground faults.

In trying to correlate the results of theoretical work with operating experience, some discrepancy in individual cases may appear. This is to be expected because of the numerous factors affecting the probability of occurrence in specific instances. That is, in a circuit which theoretically can give rise to undesirable transient overvoltages or structural damage from excessive fault current, it is entirely possible that the probability of getting just the right combination of circumstances to produce the hazardous result is small. Consequently, it might take a long period of time or wide experience to prove that a particular circuit arrangement is hazardous.

The preceding figures indicated some of the disadvantages of ungrounded neutral systems, and some troubles which can arise in improperly-grounded systems. Consider now a properly-grounded system, and how it is possible to utilize the ground fault current to locate and remove the fault.

Figure 6 shows a system with the generator neutral grounded through a current-limiting resistance. The generator feeds into a bus from which several feeder circuits originate. The generator has differential and residual backup relaying as shown. Feeders B

and C show alternate methods of overload and residual relaying. The backup relay at A is set for a longer time than the residual relays located at the locations B and C, so that selectivity is obtained.

In reducing the ground current magnitude by neutral impedance, it is necessary to make sure that:

1. The current is not reduced to such an extent that excessive transient overvoltages will result from switching transients from application of faults.

2. Adequate current must be provided for ground fault relaying anywhere in the system. The ground fault current supplied to the relay must be large compared to fictitious ground currents resulting from current transformer unbalance errors, to avoid nuisance tripouts.

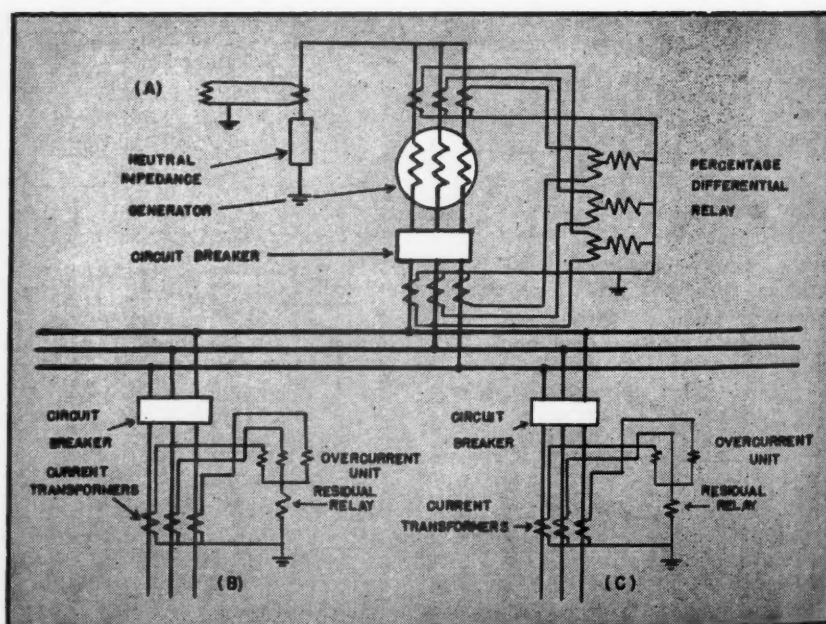
3. Where lightning arresters are selected on the basis of a grounded neutral system, the grounding impedance must be low enough to limit the electrical displacement of the neutral to provide satisfactory operation.

4. Fault currents in apparatus must be limited to values which the apparatus can safely withstand.

For most reactance-grounded systems, the ground fault current must exceed 25 percent of the system three phase fault current, to avoid serious transient overvoltages. If resistance grounding is used, adequate ground fault current for relaying will normally result in satisfactory system performance from the standpoint of transient overvoltages.

To establish the magnitude of the current required for relaying, it is necessary to consider the current transformers and relays used.

The relay characteristics are, of course, available; ideally, one would (Continued on page 201)



**FIG. 6—Typical relay connections.**

# "Relight America"

**F**ORTY years ago, when the Illuminating Engineering Society was started, we were able to secure with carbon filament lamps and gas mantles general illumination of the order of perhaps two or three footcandles of artificial lighting. That sounds pitifully small today, but considering the limited means then available it wasn't bad.

During the intervening years, as sources and equipments improved and as more knowledge was gained, our lighting attainment advanced at accelerating pace. This was impressed upon our several committees, who during the past two years have been reviewing all of our Recommended Practices for lighting different occupancies. What we thought was good lighting a decade ago is by today's standards wholly inadequate.

For similar reasons all pre-war lighting is out of date, and the same holds true for a large part of the war lighting. Though this continent may enjoy better lighting than all the rest of the world, judged by what we now know is obtainable, it is under-lighted. America needs relighting throughout.

The enthusiasm in the industry for a campaign to relight America stems not so much from the fact that we are able to provide more and better light and utilize it to better advantage than we could a decade ago, as it does from the fact that improved lighting can do so much good for the people of this continent.

On our streets, for instance, there were nearly thirty thousand traffic fatalities last year, two-thirds of which occurred at night. In other words, at a period when there was half as much traffic moving there were twice the fatalities! The answer is obvious, and we are hopeful that the cities of this country will not be long in accepting our new Recommended Practice for Street and Highway Lighting.

Our schools are constantly speeding up the tempo of instruction, in order to accommodate the

ever-increasing knowledge the children must assimilate. There are no more hours so there must be quicker reception. Improved lighting, we feel, is one way to bring this about.

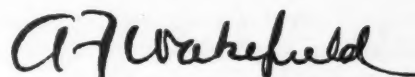
*Caveat emptor* may be a well accepted legal maxim, but it doesn't help the shopper very much. Better lighting, on the other hand, does.

Productivity of the worker, we hear on every hand, is the key to the riddle of how to pay higher wages without exacting offsetting price increases. If that be true, then improved lighting is absolutely essential in every factory. The report of our Light in War-Time Committee showed that no matter what was being made, improved lighting increased production, reduced spoilage, diminished accidents and generally contributed to better health and morale of the workers.

Compared to the public benefits, the cost of modern lighting engineered and installed in accordance with IES Recommended Practices, is picayunish. It isn't something that will take years to pay off. Rather we believe that the inadequate lighting of yesterday is costing the public each day vast sums, thousands of lives and quantities of much needed production—all of which could be saved by intelligent relighting.

Yes, America needs relighting.

To relight America is a tremendous job. It is the sum of all the jobs of relighting the places where the people of the nation live, move and have their beings. Each seller and installer of lighting must do his part. To each of these I commend the activities of the trade groups, most of whom base their recommendations upon the studied results of your Society's 25 technical committees.



President, Illuminating  
Engineering Society



# WHERE TO SELL

## Commercial and Industrial Lighting

**B**ECAUSE the equipment and techniques for it have become available for it first, the first task in the self-imposed assignment of the lighting industry to "Relight America!" is the selling of modern lighting in commercial, industrial and related fields, in stores, shops, factories, offices, theatres, churches, etc., and on the public ways. This market is comprised of between 4 and 5 million places of business and other resorts, and of some 42,500 miles of highways and streets. It is the purpose here to indicate the proportions and characteristics of the many components of this diverse market in such terms that sellers and installers of modern lighting may be helped to determine the lighting business potentialities of the communities in which they operate.

The data presented here as indicative of the commercial and industrial market are all of pre-war origin, mostly 1939 and 1940 figures published by the Census Bureau. Although not exact as of today, these figures are still valid as indicators, particularly so when reduced to population relationships as has been done here. By applying these ratios to the local population figure, the seller of lighting can set bases for estimates of the market in this area.

### *Retail Establishments*

For instance, it can not be said that the 1939 Census figure of 200,303 grocery stores is correct for today. But the figure of 637 people per grocery store may reasonably be used to calculate that a community of 25,000 population should have about 40 grocery stores. In like fashion and always, of course, with proper consideration of known local conditions, the components of the local market can be estimated, in "more or less" terms, it is true, but much better than no estimate at all. Knowing these components, and the kinds and methods of lighting to meet their requirements as disclosed on the pages following this discussion, selling efforts can be given specific directions and thus be more resultful.

The accompanying tabulation of retail establishments (Table 1) says there is a retail store of some kind or other for every 75 people in the country. In a community of 25,000 people, that means around 340 possible buyers of lighting as a profit maker. Largest single group of retail establishments is food stores, one to each 234 of population, over a hundred of them in a town of 25,000. Considering the many distinctive applications of lighting that can be made in food stores, this is a field well worth cultivating. The same town, accord-

ing to the table, should have 50 or so filling stations, each one a prospect for attention-compelling outdoor lighting.

There are 35 kinds of stores listed in the table of retail establishments. This number does not by any means state all the different kinds of stores in the country. But the 35 listed are sufficient to give an idea of the diversity in this one segment of the lighting market and of its sales possibilities.

### *Service Establishments*

In that community of 25,000, earlier instanced, there are about 125 service establishments of various kinds. Around 25 of them are barber shops, and 16 are beauty parlors, 14 are automotive repair shops, and 11 are shoe repair and shine shops. So says the tabulation of retail establishments in relation to population (Table 2). The four above-named constitute about one half of all the service establishments in any community and they make a nice bit of lighting sales business.

Additional to retail and service establishments, definitely classifiable as such, there is a third large segment of the commercial lighting market (Table 3). The table shows population relationships of the establishments listed, but use of these ratios in the determination of local markets may not in all instances be made so confidently as in the cases of occupancies listed in the first two tabulations. It is quite permissible for churches, schools, banks, theatres, billiard and pool parlors, and professional offices to be taken as fairly evenly distributed according to population, but other offices, hotels, wholesale trade establishments, public buildings, hospitals are likely to be found in larger numbers in large communities than in small. And certainly it may not be assumed, from the ratio figure of 1197, that a community of 25,000 can be expected to have 20 railroad stations.

### *Industrial Lighting Market*

Probably the 1939 Census figures of manufacturing establishments are farther off from the conditions of today than are those of trade and service. However, the breakdown of the 1939 figures reveals circumstances that are not likely to have changed greatly and that can be used in appraisal of local markets for industrial lighting.

First is the fact that only a very few of the manufacturing establishments in this country are big enough to be dignified by the term "industrial plant." Most of them are just "factories" or "shops," when classified

TABLE 1. Retail Establishments

Occupancies	Number of Establishments	Population per Establishment
Grocery stores.....	200,303	657
Combination grocery and meat stores.....	187,034	704
Meat and fish markets.....	42,360	3,110
Fruit and vegetable markets.....	27,666	4,760
Dairy products stores.....	16,834	7,820
Candy, nut and confectionery stores	48,015	2,740
Other food stores.....	38,337	3,435
General merchandise stores, department stores included.....	57,381	2,295
Dry goods stores.....	15,628	8,420
Variety stores.....	16,946	7,770
Men's, boys' clothing, furnishings	21,501	6,120
Family clothing stores.....	10,053	13,100
Women's ready-to-wear stores....	25,820	5,110
Accessories, other apparel stores..	29,098	4,530
Shoe stores.....	20,487	6,420
Furniture stores.....	19,902	6,620
Other home furnishing stores.....	12,012	10,960
Household appliance, radio stores.	20,913	6,310
New and used motor car dealers..	41,607	3,165
Accessory, tire, battery dealers...	18,525	7,120
Filling stations.....	241,858	545
Lumber, building materials dealers.	25,067	5,250
Heating, plumbing, paint, electrical stores.....	14,600	9,030
Hardware stores.....	29,147	4,520
Farm implement dealers.....	10,499	12,530
Restaurants, cafeterias, lunchrooms.	99,068	1,330
Lunch counters.....	70,724	1,862
Drinking places, with meals.....	82,310	1,600
Drinking places, without meals....	53,284	2,470
Package liquor stores.....	19,136	6,880
Jewelry stores.....	14,559	9,040
Drug stores.....	57,903	2,275
Cigar stores and stands.....	18,504	7,120
Florists.....	16,055	8,100
Hay, grain and feed stores.....	16,772	7,860
Second hand stores.....	23,962	5,500
Other retail stores.....	99,148	1,328
<b>Total retail stores.....</b>	<b>1,770,355</b>	<b>75</b>

TABLE 5. Total Commercial and Industrial Sales Prospects

Kinds of Business	Number of Establishments	Population per Establishment
Retail establishments.....	1,770,355	75
Service establishments.....	646,028	208
Other commercial establishments..	1,846,617	71
Manufacturing establishments.....	184,230	714
<b>All establishments.....</b>	<b>4,447,230</b>	<b>30</b>

TABLE 2. Service Establishments

Occupancies	Number of Establishments	Population per Establishment
Barber shops (includes 4,199 combined barber and beauty shops and 1,600 bath and massage places).....	123,797	1,064
Beauty parlors.....	83,071	1,585
Cleaning, dyeing, pressing shops.	65,408	2,015
Hand laundries.....	15,245	8,570
Power laundries.....	6,773	19,400
Photographic studios.....	10,957	12,000
Shoe repair and shine shops.....	58,083	2,260
Business services.....	28,642	4,590
Automotive repair and service....	72,067	1,830
Parking lots.....	6,274	21,000
Blacksmith shops.....	16,797	7,840
Radio and electrical repair shops..	14,347	9,180
Watch, clock, jewelry repair shops	12,485	10,520
Printing shops.....	13,570	9,700
Custom service shops.....	52,283	2,520
Other service and repair shops....	66,229	1,985
<b>Total service establishments</b>	<b>646,028</b>	<b>208</b>

TABLE 3. Other Commercial Establishments

Occupancies	Number of Establishments	Population per Establishment
Theatres*.....	15,346	8,600
Billiard and pool parlors*.....	12,998	10,100
Other amusement places*.....	16,573	7,950
Hotels.....	27,987	4,700
Churches.....	253,762	520
Hospitals (estimated).....	8,000	16,500
Banks.....	15,146	8,700
Professional offices (estimated)...	175,000	750
Other offices (estimated).....	175,000	750
Schools (estimated).....	275,000	480
Public buildings (estimated).....	95,000	1,390
Railroad stations (estimated).....	110,000	1,200
Wholesale trade establishments....	200,573	640
Others unidentified.....	466,232	282
<b>Total other establishments</b>	<b>1,846,617</b>	<b>71</b>

\*Except those operated by educational, religious, charitable, and fraternal institutions, by governmental and civic bodies, and by non-profit organizations.

TABLE 4. Food Products Establishments

Occupancies	Number of Establishments	Population per Establishment
Meat products.....	3,387	38,900
Dairy products.....	9,535	13,800
Canned foods.....	3,053	43,200
Grain mill products.....	3,746	35,100
Bakery products.....	18,399	7,150
Sugar, candy, related products....	1,508	87,200
Miscellaneous food products.....	6,075	21,700
Beverages.....	5,745	22,900
<b>Total food products.....</b>	<b>51,448</b>	<b>2,560</b>

according to numbers of employees. Of the total of 184,230 manufacturing establishments reported by the 1939 Census, 168,814 have 100 or less employees each, and of this number 84,245 each have five employees or fewer.

Second is the fact that of the 184,230 establishments reported, 51,448 are processors of food or kindred products, as appears in Table 4. Such establishments are more likely to be uniformly distributed among the population than are those of other manufacturing groups.

These two facts indicate that in other than definitely industrial communities the market for industrial lighting lies in quite small establishments of which many are

processors of food. These conclusions say that the seller of lighting in the ordinary community, not highly industrialized, can still find a respectable market for industrial lighting if he will look for it.

All of these commercial and industrial establishments add up to a total of 4,447,230 prospects for the sale of lighting, one for every 30 of population (Table 5). This is to say that in that community of 25,000 the seller of lighting should be able to find around 800 prospects in the commercial and industrial fields. Possibly he won't find so many, possibly he'll find more, but, more or less, there is a real market for commercial and industrial lighting in every community in this nation.





**Commercial  
Fluorescent Lighting**

**SHIELDED LUMINOUS UNITS**

Basic designs for individual and continuous row  
fluorescent lighting equipment, with lamps shielded  
with louvers, plastic or glass.

*Sell these for lighting*

AUTOMOBILE SALES ROOMS . . . BANKS . . . COM-  
MERCIAL INTERIORS . . . DEPARTMENT STORES  
DRAFTING ROOMS . . . LIBRARIES . . . MARKETS  
OFFICES . . . RECEPTION ROOMS . . . RESTAURANTS  
SCHOOLS . . . SPECIALTY STORES . . . THEATRES

The designs shown on this page are typical examples of commercial fluorescent lighting equipment. This type equipment is sold for lighting most commercial interiors, and represents a large percentage of the total fluorescent lighting market.

Designs on this page show four 40 watt lamps in each individual unit, or in each four foot length of continuous row equipment. Location of lamps, type of reflectors, louvers, glass and plastic, govern the type of light distribution, so that varied lighting effects are obtainable, ranging from semi-direct to luminous indirect.

The same type of equipment can also be made for other standard fluorescent lamps, including

the 100 watt and the new long slim lamps, commonly referred to as "slimline". Each manufacturer achieves individuality in design through variations in ornamentation, finish, mechanical construction, and combinations of metal and glass or plastic. Practically all of these units are designed for installation on the ceiling, or for suspension by means of metal stems.

Arrangement of lamps is not limited to those shown on this page. Other arrangements, in combination with metal reflectors or diffusing media are also available, designed specifically for predetermined light distribution, and for special lighting applications.

## RELIGHT AMERICA

### Directions for Use

**V**ERSATILITY is the outstanding characteristic of lighting equipment. Few, if any, of the many forms and types of lighting fixtures and methods are inherently limited to single applications and to those only. In practically every case a lighting means designed for a specific purpose may be used effectively for at least one other purpose, and probably for many. Therefore, the applications listed with the various forms of lighting illustrated and described on this and following pages are not to be regarded as in the nature of exclusive specifications but as suggestions and reminders.

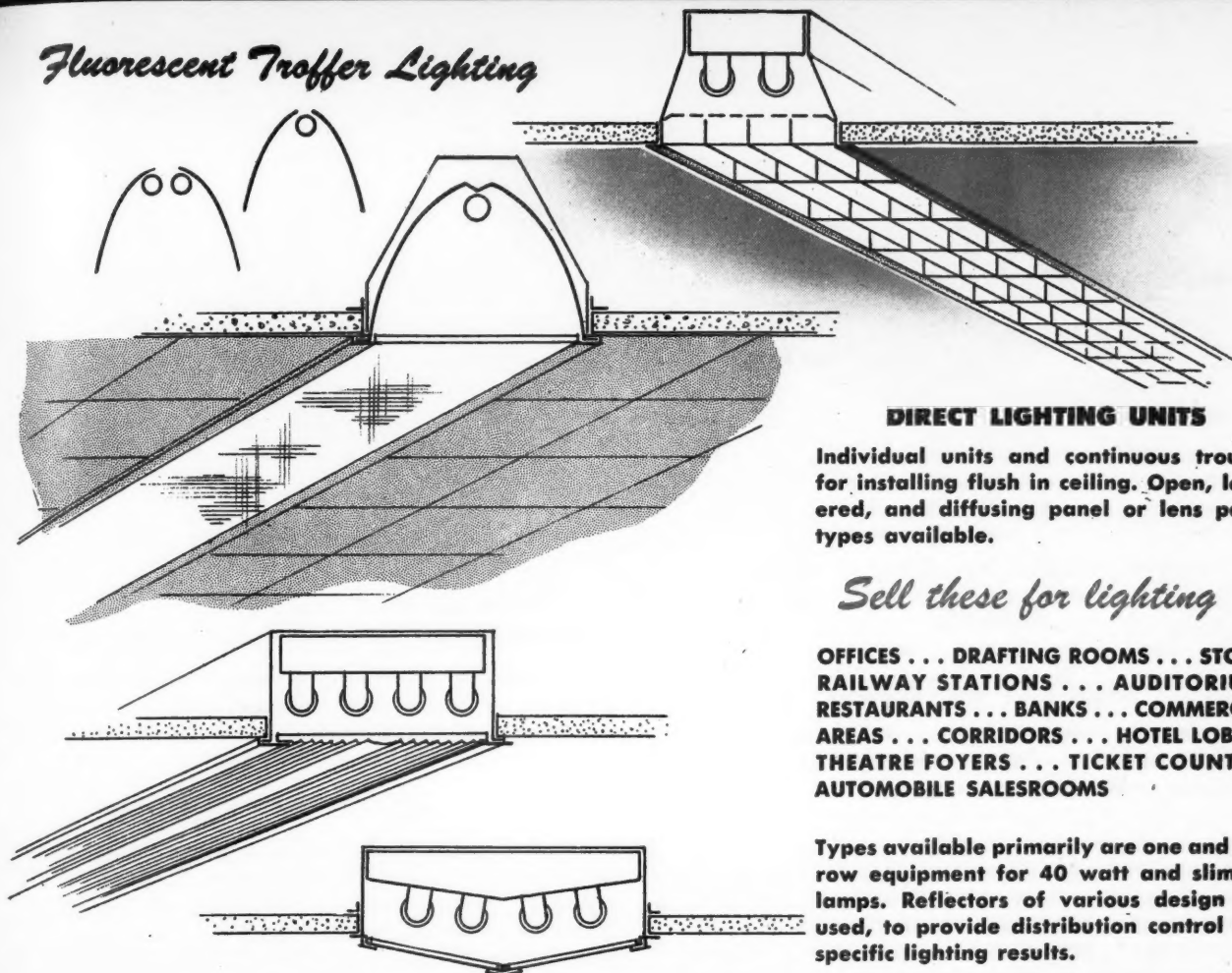
Combining these suggestions with a statistical resolution of his local market, as outlined in the text and tables on the preceding two pages, should

give to each seller of lighting a fair idea of what and how much he can sell in the commercial and industrial fields of his community.

Reasonably comprehensive coverage of the ways and methods of lighting, rather than description of fixtures and units, was aimed at in making this presentation. There will be found in designs offered by manufacturers many variants and adaptations of the ideas shown here. From these the specifier of equipment for a lighting installation must select what he thinks is best in the particular case. For this, the information given here will be helpful.

The excellent drawings that illustrate these pages are the work of Ted Mehrer, Designer and Illuminating Engineer, New York City.

## Fluorescent Troffer Lighting



### DIRECT LIGHTING UNITS

Individual units and continuous troughs for installing flush in ceiling. Open, louvered, and diffusing panel or lens panel types available.

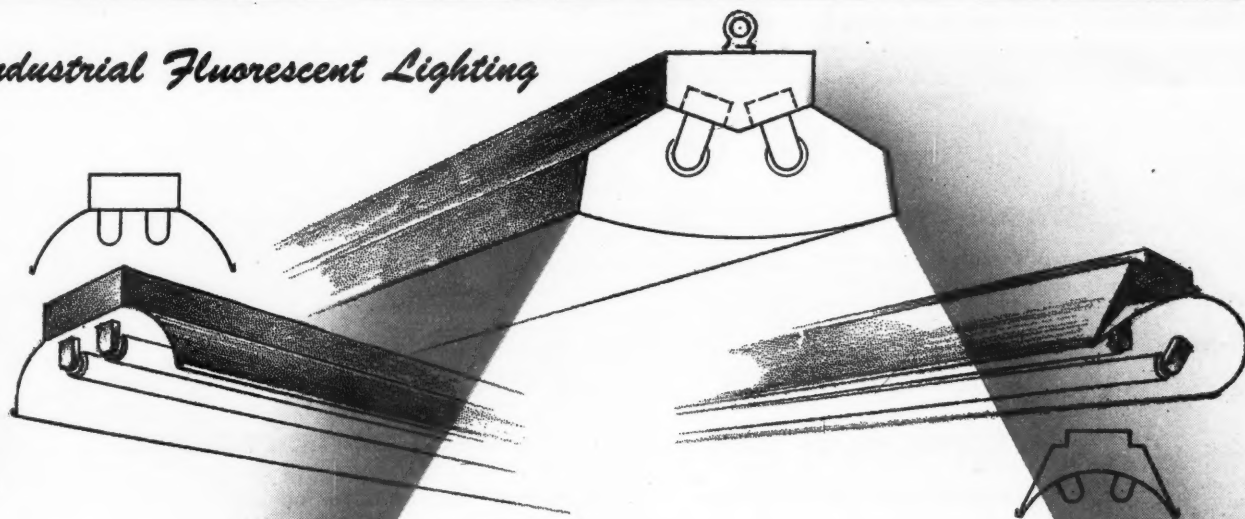
### *Sell these for lighting*

OFFICES . . . DRAFTING ROOMS . . . STORES  
RAILWAY STATIONS . . . AUDITORIUMS  
RESTAURANTS . . . BANKS . . . COMMERCIAL  
AREAS . . . CORRIDORS . . . HOTEL LOBBIES  
THEATRE FOYERS . . . TICKET COUNTERS  
AUTOMOBILE SALESROOMS

Types available primarily are one and two row equipment for 40 watt and slimline lamps. Reflectors of various design are used, to provide distribution control and specific lighting results.

## RELIGHT AMERICA

## Industrial Fluorescent Lighting



### DIRECT LIGHTING UNITS

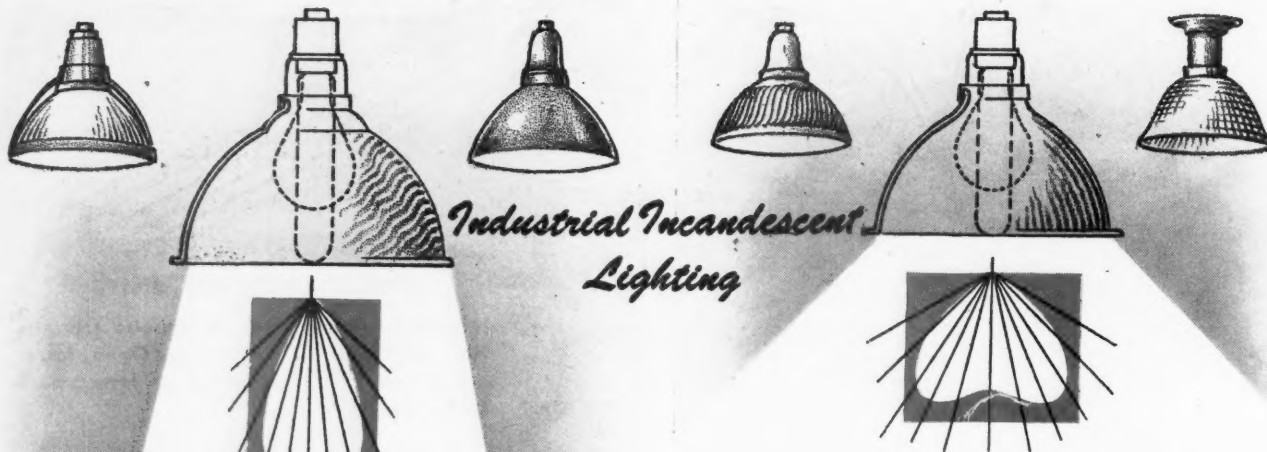
Reflectors shield lamps and control the light distribution.

### *Sell these for lighting*

FACTORIES . . . FOUNDRIES . . . PRINTING PLANTS . . . MACHINE SHOPS . . . ASSEMBLING  
AREAS . . . LAUNDRIES . . . STORAGE AREAS . . . LOW BAY AREAS . . . MEDIUM BAY  
AREAS . . . MANUFACTURING AREAS . . . MISCELLANEOUS INDUSTRIAL AREAS

Available as individual units and for continuous row installation, for installing flush, on the ceiling, and suspended. Made for one or more lamps, and for all sizes of lamps, 15 watts and larger. Reflectors are available in porcelain enameled steel, baked enamel on steel, diffuse and specular aluminum, aluminum paint on steel, etc.





## Industrial Incandescent Lighting

### HIGH BAY REFLECTORS

Concentrating and semi-concentrating type reflectors of prismatic and silver mirrored glass, and of specular or semi-diffuse aluminum.

*Sell these for lighting*

STEEL MILLS . . . AUTOMOBILE PLANTS . . . AIRCRAFT FACTORIES . . . FOUNDRIES . . . ARMORIES . . . CONVENTION HALLS . . . HIGH BAY AREAS

Available for 500 to 2000 watt incandescent lamps and 400 watt mercury vapor lamps. 3000 watt mercury vapor units (not illustrated) also available.

### MEDIUM AND LOW BAY REFLECTORS

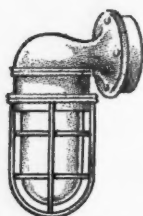
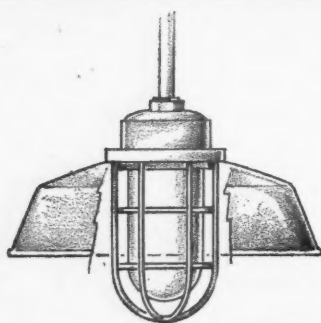
Distributing or wide spread type reflectors, of prismatic or silver mirrored glass, diffuse aluminum and porcelain enameled steel.

*Sell this for lighting*

ASSEMBLY AREAS . . . AIRCRAFT PLANTS . . . AUTOMOBILE PLANTS . . . MACHINE SHOPS . . . PRINTING PLANTS . . . RAILWAY STATIONS . . . LAUNDRIES  
MEDIUM BAY AREAS . . . LOW BAY AREAS . . . MANUFACTURING AREAS . . . TEXTILE MILLS . . . HOSIERY MILLS . . . WOOD WORKING PLANTS

Made in sizes for lamps of from 200 to 1500 watts, and for 250 or 400 watt mercury vapor lamps.

## RELIGHT AMERICA



### VAPOR PROOF UNITS

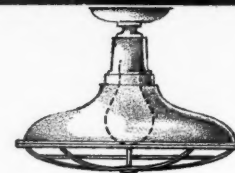
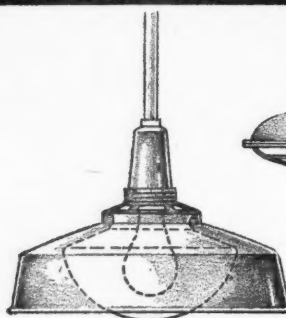
Weatherproof and vaporproof \* direct lighting type units for ceiling, pendant and wall mounting are shown at left. Reflectors at right shield the lamps and control the light distribution.

*Sell these for lighting*

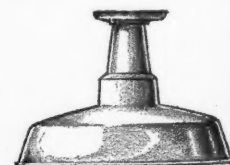
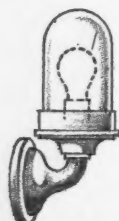
AUTOMOBILE GREASE PITs . . . BOILER ROOMS . . . COLD STORAGE VAULTS  
DAMP LOCATIONS . . . DUSTY AREAS . . . EXTERIORS . . . FACTORIES  
GASOLINE SERVICE STATIONS . . . INDUSTRIAL AREAS . . . LOADING PLATFORMS . . . LOCALIZED WORK AREAS . . . LOCKER ROOMS . . . LOW BAY AREAS . . . MACHINE SHOPS . . . RAILWAY PLATFORMS . . . STEEL MILLS  
STOCK BINS . . . STORAGE AREAS . . . TRANSFORMERS . . . WORK BENCHES

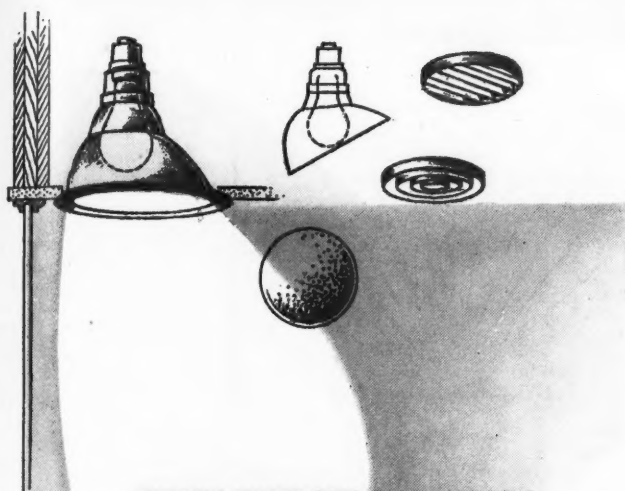
Available for standard incandescent lamps ranging from 50 to 1500 watts, with reflectors of shallow, medium, deep and angle types. Fittings are furnished in a variety of types for different mountings.

\* Check National Electrical Code for classification of areas for hazard where vapor-proof is permitted. Explosion proof type equipment is required for some areas in lieu of vaporproof.



### DIRECT LIGHTING REFLECTORS





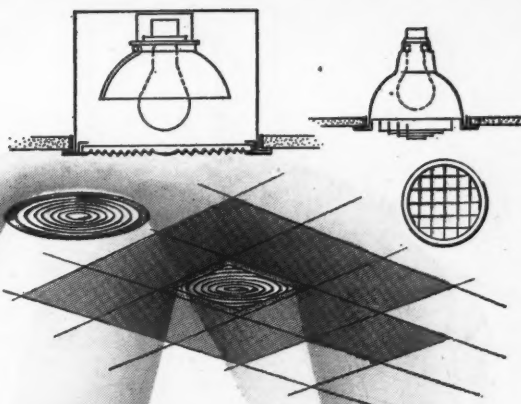
### SHOW WINDOW REFLECTORS

Reflectors, ceiling flanges, louvers and color roundels are used for display lighting.

*Sell these for lighting*

SHOW WINDOWS . . . WALL CASES . . . FEATURE DISPLAYS . . . MURALS . . . ART OBJECTS

For use with 50 to 1000 watt standard incandescent lamps, having concentrated, semi-concentrated and diffuse asymmetric light distribution. Available in prismatic and silver mirrored glass, with some types in aluminum.



### DIRECT LIGHTING INCANDESCENT UNITS

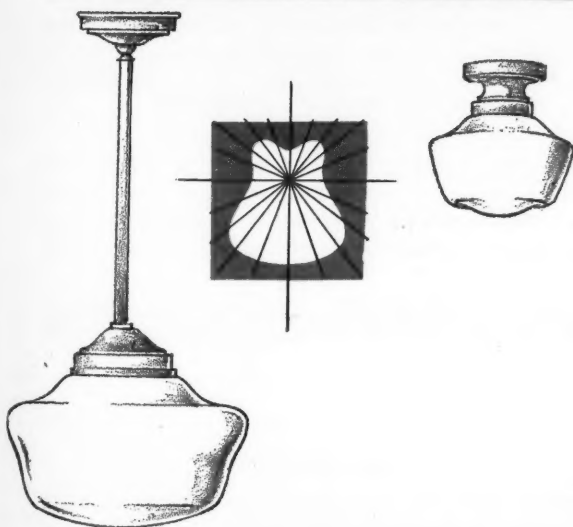
Individual incandescent units for recessed mounting in ceiling, lens and louver types.

*Sell these for lighting*

COMMERCIAL INTERIORS . . . SALES AREAS  
RESTAURANTS . . . RETAIL ESTABLISHMENTS  
COUNTER DISPLAYS . . . LOBBIES . . . SERVICE  
COUNTERS . . . CAFETERIAS

Provides general or specific direct lighting with 100 to 500 watt incandescent lamps, and shields lamps and reflectors from normal viewing angles. Lenses available round or square, and louvers of eggcrate, concentric, parallel or other types.

## RELIGHT AMERICA



### SEMI-DIRECT INCANDESCENT UNITS

Enclosing glass diffuses light from lamps, controls brightness and light distribution to some extent.

*Sell these for lighting*

RETAIL ESTABLISHMENTS . . . CORRIDORS . . . SERVICE AREAS . . . STORAGE . . . KITCHENS . . . PUBLIC TOILETS . . . BASEMENTS

Available in various shapes from ball globes to artistic designs, in diameters of eight to 20 inches.



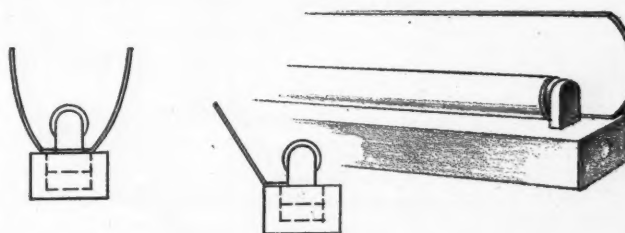
### FLUORESCENT LIGHTING CHANNEL

Consists of wiring channel, lamp holders and bare lamp. May be used bare or with various type reflectors.

*Sell these for lighting*

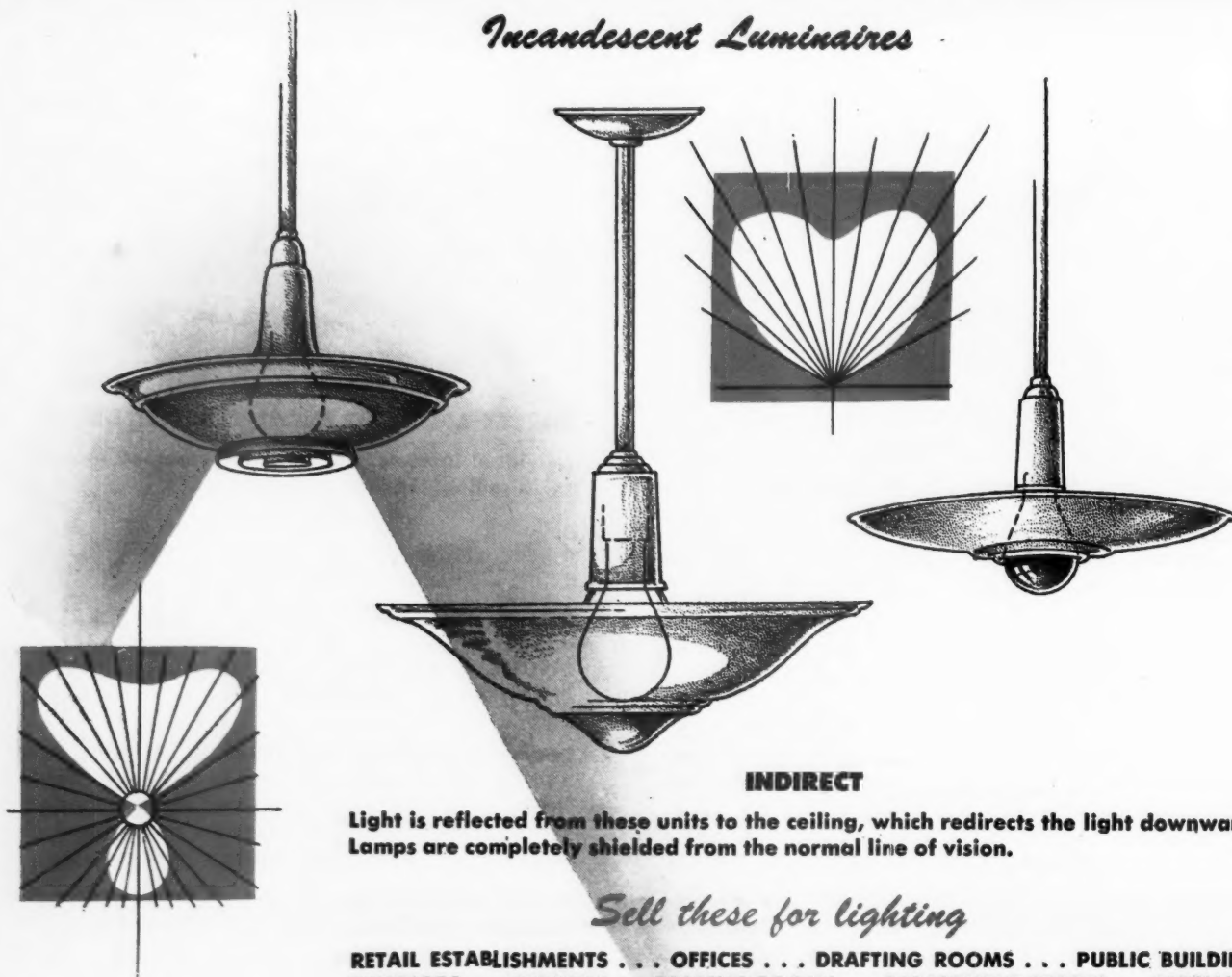
CABINETS . . . WALL CASES . . . DISPLAY CASES  
IN COVES . . . IN DISPLAY NICHES . . . DECORATIONS  
IN SOFFITS . . . ARTIFICIAL SKYLIGHTS . . . ARCHITECTURAL ELEMENTS

Available for fluorescent lamps of 15, 20, 30, 40 and 100 watt sizes. May be used in individual units or continuous sections. Many uses can be found for this equipment, considered as a basic lighting component for special lighting applications.





## Incandescent Luminaires



### INDIRECT

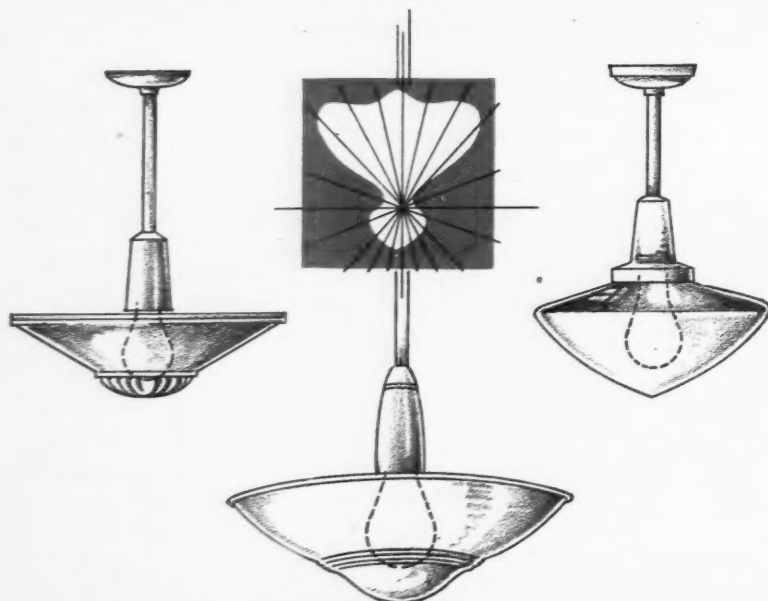
Light is reflected from these units to the ceiling, which redirects the light downward. Lamps are completely shielded from the normal line of vision.

### *Sell these for lighting*

RETAIL ESTABLISHMENTS . . . OFFICES . . . DRAFTING ROOMS . . . PUBLIC BUILDING INTERIORS . . . LIBRARIES . . . READING ROOMS . . . DEPARTMENT STORES . . . SPECIALTY STORES . . . RESTAURANTS . . . AUDITORIUMS . . . SCHOOLS . . . CLASS ROOMS  
COMMERCIAL INTERIORS . . . BANKS . . . RECEPTION ROOMS . . . LOBBIES

Available with plain and ornamental type bowls for use with 200 to 1500 watt standard and bowl silvered lamps. Equipped with porcelain enameled steel, silver mirrored glass or aluminum reflectors. Bowls are of metal, glass, plastic or composition and, combined with plain or ornamental suspensions, are supplied in a variety of finishes.

## RELIGHT AMERICA



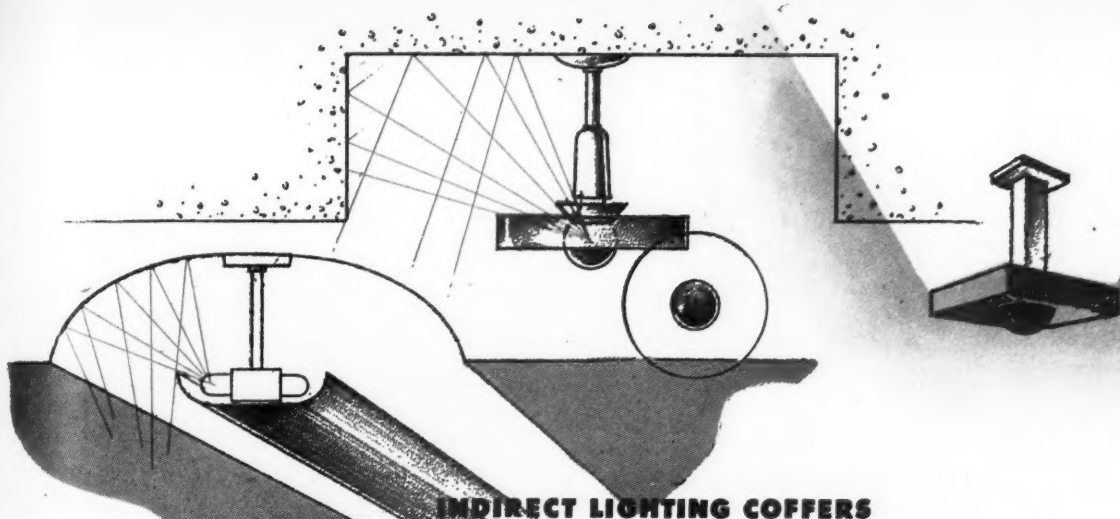
### SEMI-INDIRECT

These units are similar to indirect luminaires, except that a small percentage of the light is transmitted through a diffusing medium.

### *Sell these for lighting—*

AUDITORIUMS . . . CLASS ROOMS . . . COMMERCIAL INTERIORS . . . RETAIL ESTABLISHMENTS  
PUBLIC BUILDING INTERIORS . . . DRAFTING ROOMS . . . OFFICES . . . RESTAURANTS . . . LOBBIES

Bowls are made of plastic, glass, or a combination of metal and plastic, or of metal and glass. Sizes are available for standard lamps of from 200 to 1500 watts. Suspensions may be plain or ornamental.



### INDIRECT LIGHTING COFFERS

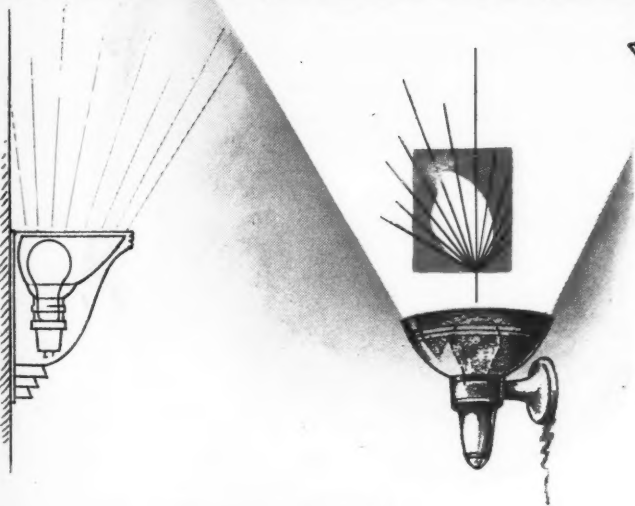
Lighting units are installed in coffers formed in the ceiling. Coffers for incandescent units are usually square, and for fluorescent troughs are usually continuous.

*Sell these for lighting*

BOARD ROOMS . . . BANKS . . . RECEPTION ROOMS . . . LOBBIES . . . DINING ROOMS  
OFFICES . . . STORES . . . LIBRARIES . . . DRAFTING ROOMS . . . PUBLIC BUILDING  
INTERIORS . . . NIGHT CLUBS

Provides well diffused illumination efficiently. Units may be designed to fit the architectural details, or architectural elements may be planned for standard equipment.

## RELIGHT AMERICA



### WALL URNS

Individual reflector units for incandescent lamps designed for wall mounting. Reflectors provide asymmetric light distribution to light ceiling uniformly and prevent undue brightness on wall above urn.

*Sell these for lighting*

RECEPTION ROOMS . . . LOBBIES . . . FOYERS  
PRIVATE OFFICES . . . REST ROOMS . . . NIGHT CLUBS  
TEA ROOMS . . . SPECIALTY STORES . . . LIBRARIES  
THEATRES

Plain and ornamental types are available for 200 to 1000 watt standard lamps. Silver mirrored glass and aluminum reflectors are housed in metal or combinations of metal, glass and plastic.



### INDIRECT PEDESTAL

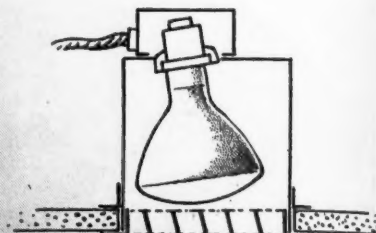
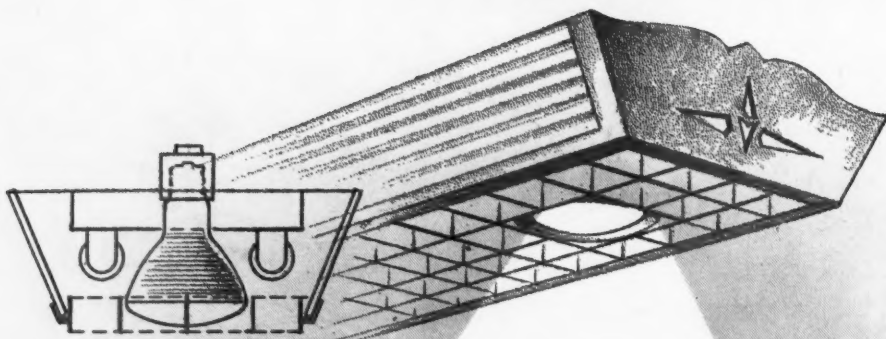
Indirect lighting from ornamental floor pedestals or low wall partitions.

*Sell these for Lighting*

LOBBIES . . . REST ROOMS . . . RECEPTION ROOMS . . .  
SMALL OFFICE . . . HOSPITAL WARDS . . . LIVING  
ROOMS . . . POWDER ROOMS . . . SPECIALTY STORES  
. . . FOYERS . . . RESTAURANTS

Provides well diffused illumination free from glare. Pedestal may combine incandescent lamp and fluorescent circular lamp, with separate switch control. Either fluorescent or incandescent lamps may be used in wall partition.





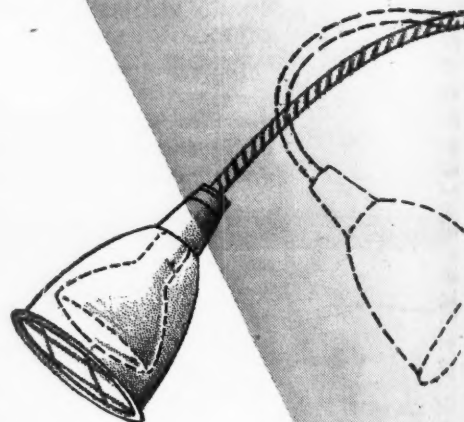
### REFLECTOR LAMPS

Spot and Flood reflector lamps can be used for many special lighting applications. Accessories, such as color hoods, louvers, swivel bases, flexible arms, and universal swivel mounting rings broaden and refine these applications.

### *Sell these for lighting*

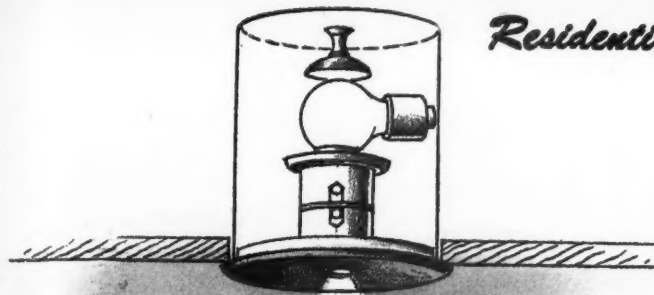
**FEATURE DISPLAYS . . . SHOW WINDOWS . . . INTERIOR MODELS . . . SALES FEATURES . . . BILLBOARDS  
COUNTER DISPLAYS . . . AUTOMOBILES . . . WORK  
AREAS . . . INDUSTRIAL MACHINES . . . SPEAKER'S  
STANDS**

These lamps, commonly referred to as R-40 reflector spot, or reflector flood lamps, combined with the many accessories, are considered as basic lighting components. Only a few typical accessories and applications are shown on this page. Their flexibility and use in obtaining unusual lighting effects, both in white lighting and in color, is limited only by the ingenuity and imagination of the lighting engineer. They are available in 150 watt and 300 watt sizes.



**RELIGHT AMERICA**

## Residential Lighting



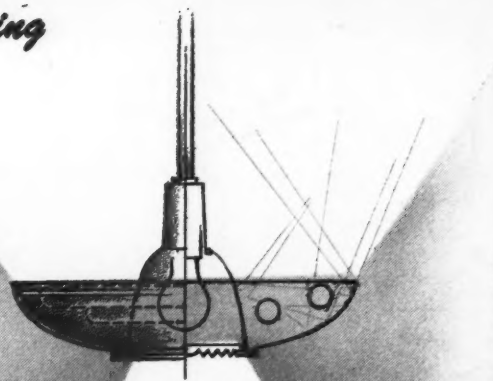
### PIN HOLE SPOT

Produces an accurately controlled beam of light, which may be shaped in any desired pattern.

*Sell these for lighting*

#### THE DINING ROOM TABLE

Recessed flush in the ceiling over the center of the dining room table, a beam of light can be made to accurately frame the table, regardless of shape, so that the table is highlighted while no direct light reaches the diners.



### DINING ROOM FIXTURE

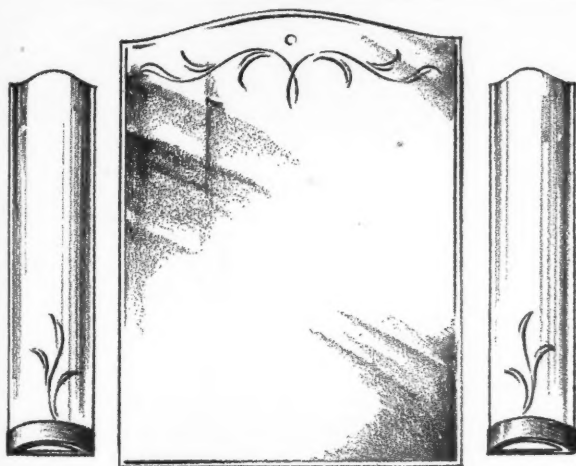
A combination two-circuit fixture designed specifically for lighting the dining room.

*Sell these for lighting*

#### DINING ROOMS

General illumination floods the room from circline lamps placed above the luminous plastic or glass bowl. Direct illumination for lighting the table comes from the incandescent lamp concealed in the reflector, producing direct lighting only. Fixture is wired so that each lighting effect is controlled by a separate switch.

## RELIGHT AMERICA



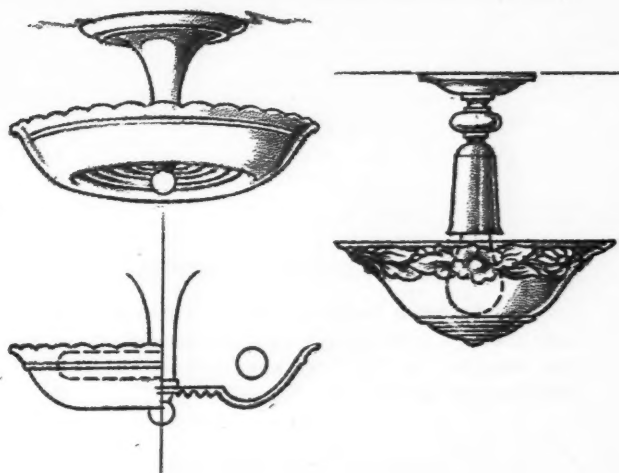
### MIRROR LIGHTING

Low brightness long light sources, one on each side of mirror, for shadowless and non-glaring lighting.

*Sell these for lighting*

BATH ROOM MIRRORS . . . REST ROOM MIRRORS  
LADIES' LOUNGE MIRRORS . . . LAVATORIES

Tubular incandescent or small fluorescent lamps, concealed behind glass or plastic shields, provides a uniformly illuminated diffuser, which is non-glaring. The long light source prevents shadows on the face and provides uniform lighting.



### BEDROOM FIXTURES

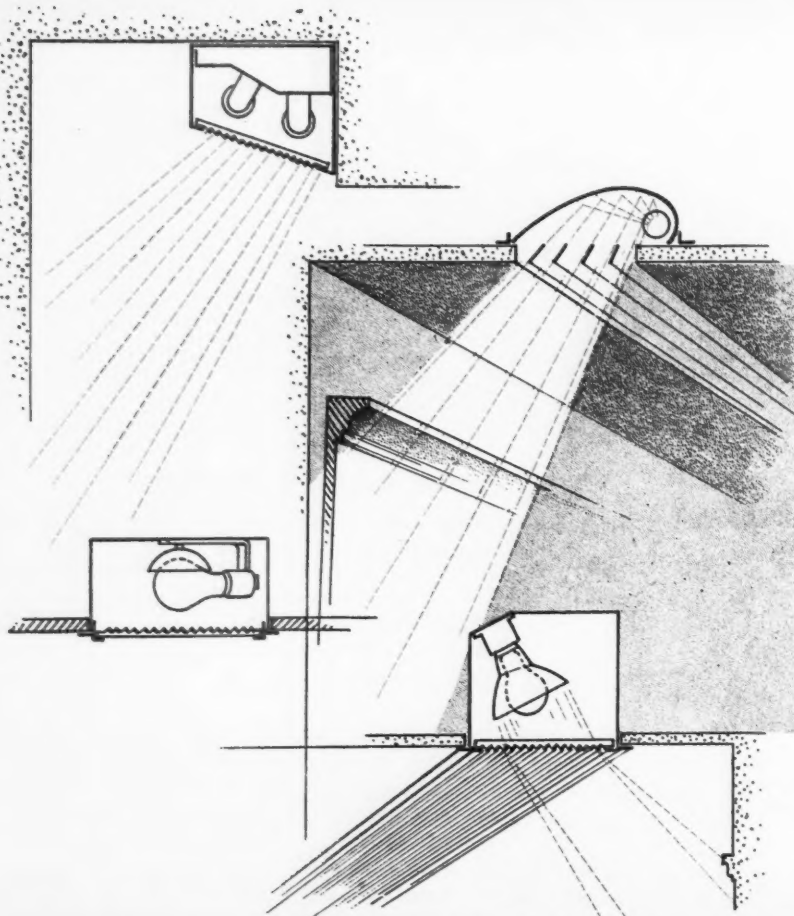
Semi-indirect and indirect ceiling pendant units designed to produce uniform general illumination.

*Sell these for lighting*

BED ROOMS . . . FOYERS . . . HALLWAYS . . . REST ROOMS . . . DRESSING ROOMS

These ceiling units utilize glass or plastic for bowls, which serve as reflectors, and as shields for the lamps. Incandescent lamps up to 150 watts, or circular fluorescent lamps may be used as the light source in these units.





### MURAL LIGHTING

Asymmetric light distribution for uniform illumination intensity over large vertical surfaces.

*Sell these for lighting*

MURALS . . . THEATRE LOBBIES . . . WALL DISPLAYS . . . RESTAURANTS . . . ART MUSEUMS . . . WAR MEMORIALS . . . INTERIOR SIGNS . . . BLACKBOARDS IN CLASS ROOMS

Light sources are completely shielded, and light is directed toward wall area, away from the observer. This type equipment can also be installed flush in the wall with light distribution directed to ceiling for indirect lighting effects.

RELIGHT AMERICA

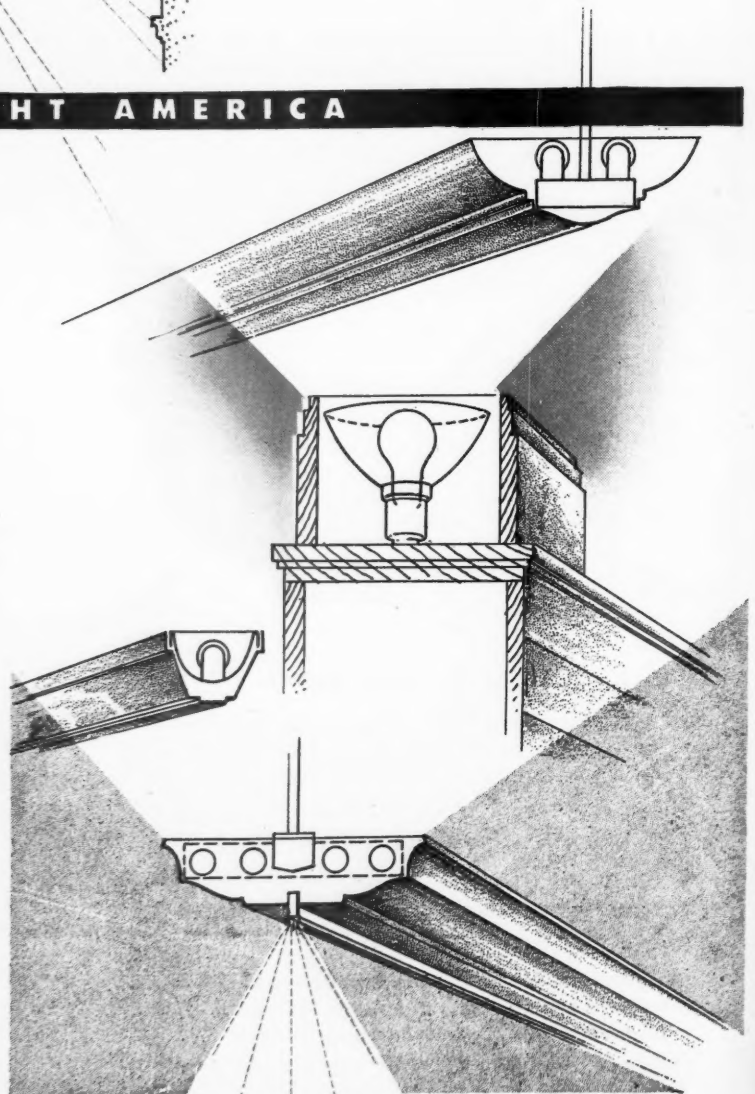
### INDIRECT FLUORESCENT LIGHTING

Soft comfortable lighting from concealed light sources, using standard indirect lighting troughs or lighting components in architectural elements.

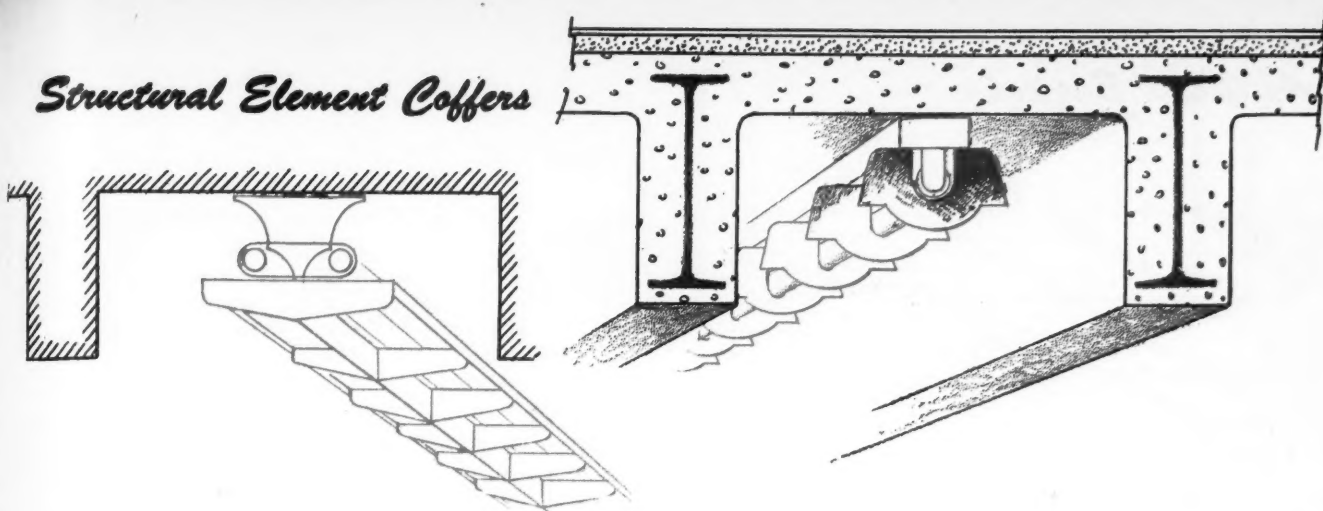
*Sell these for lighting*

SCHOOLS . . . CLASS ROOMS . . . CHURCHES AUDITORIUMS . . . OFFICES . . . DRAFTING ROOMS . . . BANKS . . . PUBLIC INTERIOR AREAS . . . STORES . . . LOBBIES . . . RECEPTION ROOMS

High lumens per watt from fluorescent light sources make fluorescent ideal for indirect lighting. The size and shape of fluorescent tubes are well suited for adaptation to architectural elements.



## Structural Element Coffers



### SHIELDED DIRECT LIGHTING

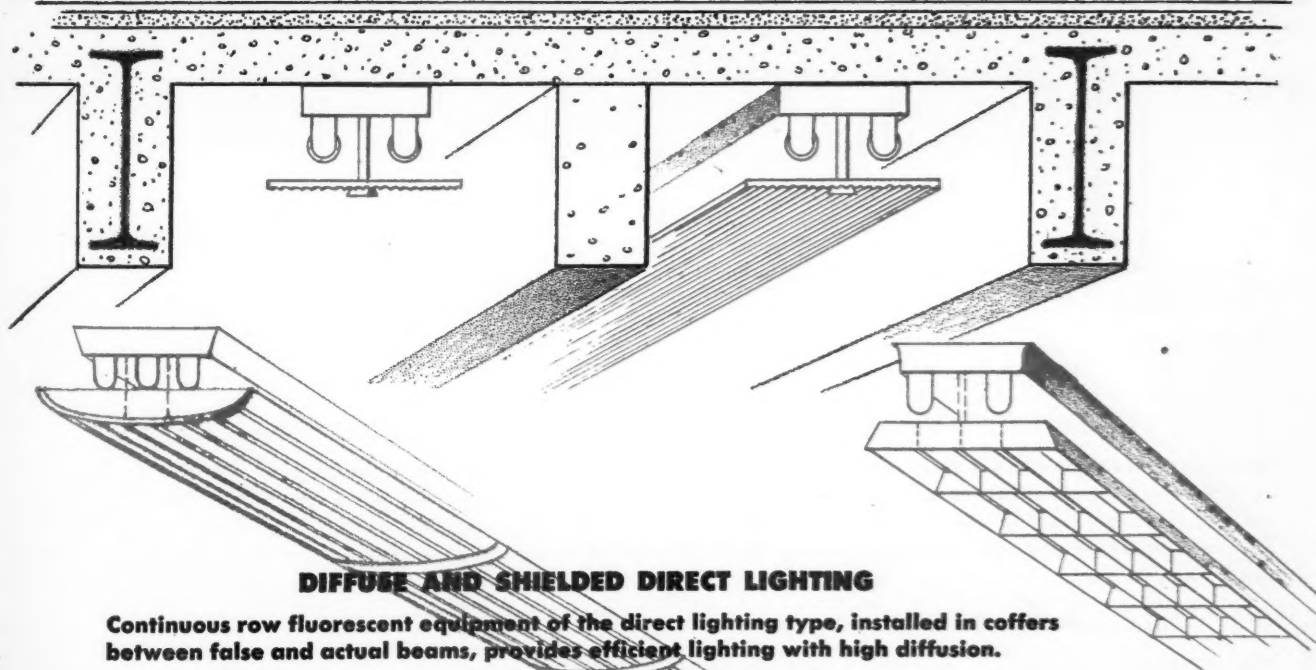
Coffers formed by structural beams form ideal lighting troughs for single-lamp or two-lamp continuous fluorescent lighting equipment.

### *Sell this for lighting*

COMMERCIAL AREAS . . . FOOD MARKETS . . . OFFICES . . . INDUSTRIAL PLANTS . . . CONVENTION HALLS . . . BOWLING ALLEYS . . . DISPLAY ROOMS

Single row 40 watt or 100 watt fluorescent lamps, and single or double row slimline lamps, equipped with louvers for shielding the lamps from view in the normal line of vision, provide ideal equipment for installation in troffers formed by structural beams. Beams form the necessary shielding normal to the lamps, and cross louvers shield the lamps along their length. Width of troffer should not exceed twice its depth, for proper shielding.

## RELIGHT AMERICA



### DIFFUSE AND SHIELDED DIRECT LIGHTING

Continuous row fluorescent equipment of the direct lighting type, installed in coffers between false and actual beams, provides efficient lighting with high diffusion.

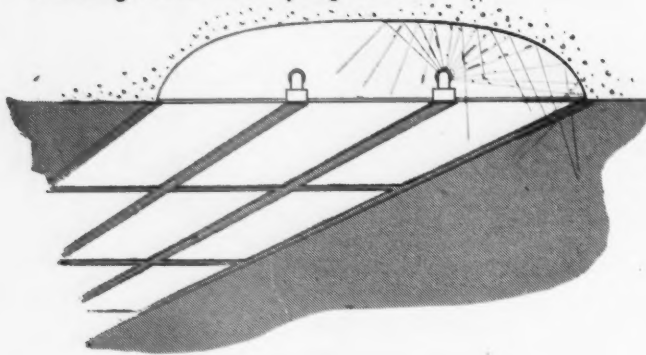
### *Sell these for lighting*

AUTOMOBILE SALES ROOMS . . . BANKS . . . COMMERCIAL AREAS . . . DRAFTING ROOMS  
DEPARTMENT STORES . . . DISPLAY ROOMS . . . OFFICES . . . STORES . . . INSPECTION  
AREAS . . . INDUSTRIAL PLANTS

Coffers are formed by natural beam construction and applied false beams. They are painted flat white to provide a high reflection factor. Beams shield the equipment normal to the troffer, and diffusing glass or cross louvers shield the lamps along the troffer. The lighted troffer surrounding the direct lighting type equipment reduces brightness contrast and provides an ideal lighting result, high in efficiency.

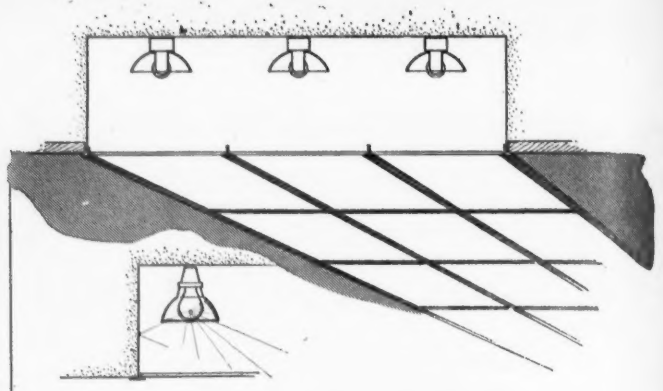


## Artificial Skylights



**INDIRECT LIGHTED PANELS**

Large area, low surface brightness diffusing panels of glass, plastic or other diffusing media, are installed flush in ceiling, walls or columns. Light sources and reflecting equipment are installed behind the diffusing panels, properly spaced to provide uniform brightness on the panels.



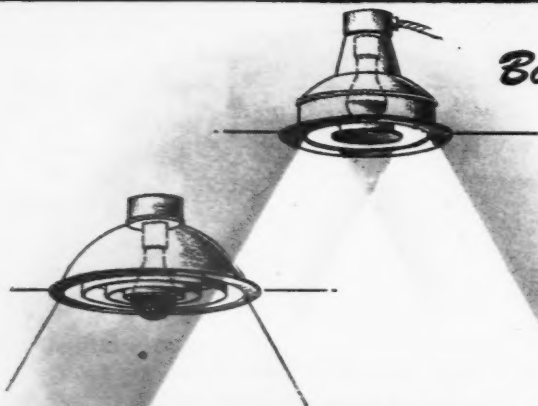
**DIRECT LIGHTED PANELS**

## *Sell these for lighting*

AUDITORIUMS . . . AUTOMOBILE SALES ROOMS  
ART GALLERIES . . . BANKS . . . BANQUET ROOMS  
BOWLING ALLEYS . . . CORRIDORS . . . CLASS ROOMS  
COMMERCIAL AREAS . . . COURT ROOMS . . . DRAFTING ROOMS . . . FOYERS . . . FURNITURE STORES  
INSPECTION AREAS . . . LOBBIES . . . OFFICES  
PRIVATE OFFICES . . . PUBLIC BUILDINGS . . . RECEPTION ROOMS . . . RESTAURANTS . . . RETAIL ESTABLISHMENTS . . . STORES . . . THEATRES . . . WAITING ROOMS

This system of lighting provides well diffused illumination, with color quality of light controllable through change of light sources and careful selection of diffusing medium. Area of panels may be large or small, and may be controlled as to shape and pattern, to harmonize with architectural treatment. Fluorescent or incandescent light sources may be used. Spacing of light sources should be selected which will provide uniform illumination on the diffusing panels, and present an evenly illuminated appearance.

## RELIGHT AMERICA



**LOUVERED REFLECTORS**

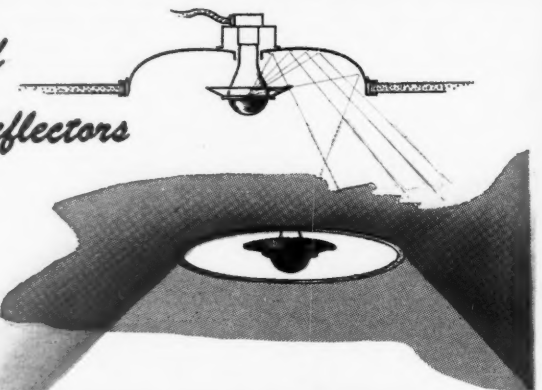
Bowl silvered lamps used with semi-distributing or concentrating type reflectors, louvered to prevent view of luminous part of lamp, produce a medium or concentrated beam of light with very little brightness at units.

## *Sell these for lighting*

RESTAURANTS . . . LOBBIES . . . FOYERS . . . SPECIALTY STORES . . . WAITING ROOMS . . . RECEPTION ROOMS  
INFORMATION DESKS

Recessed flush in ceiling, these typical "down" lights are inconspicuous either lighted or unlighted. They can be used to subtly highlight a local area in a softly illuminated interior without accentuating the source of the light. Lighting salesmen and engineers can find many uses for these units, for lamps from 200 watts to 1000 watts in size.

## *Bowl Silvered Lamp Reflectors*



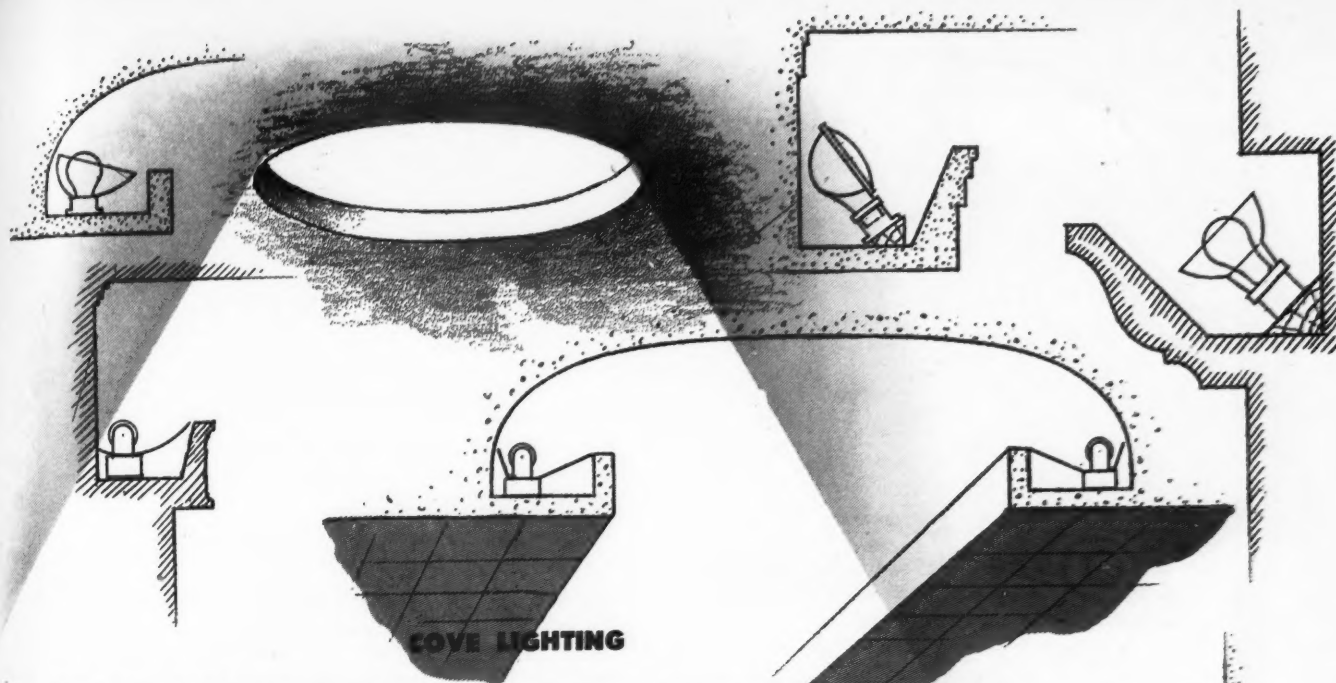
**SHIELDED LAMP REFLECTORS**

Diffuse illumination, or wide angle distribution of light, is obtained from the large diameter mat finished reflector and bowl silvered lamp. Metal cone shield eliminates glare from the upper part of the lamp.

## *Sell these for Lighting*

DISPLAY ROOMS . . . RETAIL ESTABLISHMENTS  
RESTAURANTS . . . STORES . . . FOOD MARKETS  
SERVICE ESTABLISHMENTS . . . BANQUET ROOMS  
BOARD ROOMS . . . LABORATORIES . . . UNDER BALCONIES

These units may be recessed in ceiling, or suspended from the ceiling. The 200 watt to 500 watt sizes are practical for many lighting applications. The wide angle of light spread makes these units ideal for use in areas having low ceilings where an indirect lighting effect is desired.



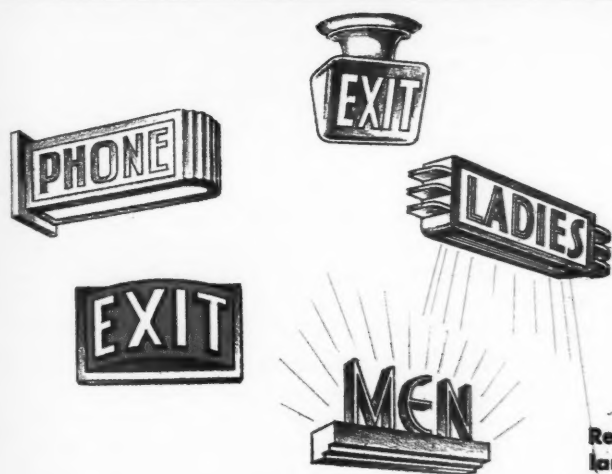
Reflectors installed in coves, cornices and ceiling domes are used to obtain soft, comfortable indirect lighting, without the use of ornamental or utility type fixtures hanging from the ceiling.

### *Sell these for Lighting*

AUDITORIUMS . . . ART GALLERIES . . . BANKS . . . BOARD ROOMS . . . PRIVATE OFFICES  
LODGES . . . RECEPTION ROOMS . . . THEATRES . . . RESTAURANTS . . . RETAIL ESTABLISHMENTS . . . CHURCHES . . . PUBLIC BUILDINGS . . . LOBBIES

Fluorescent and incandescent light sources are both easily adaptable to cove lighting. Color roundels can be used with incandescent lamps for color effects, especially where dimming is appropriate. Ceilings or domes should be finished mat white for cove lighting installations.

## RELIGHT AMERICA

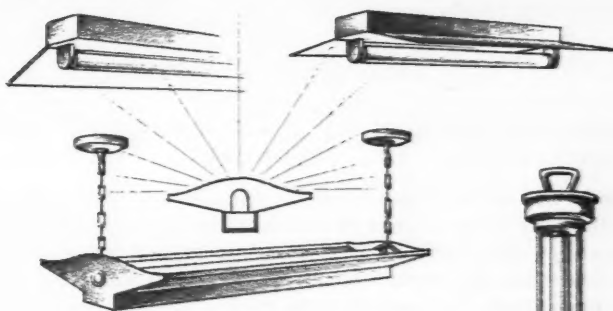


### ILLUMINATED DIRECTIONAL SIGNS

#### *Sell these for use in*

THEATRES . . . HOTELS . . . OFFICE BUILDINGS  
STORES . . . RAILWAY STATIONS . . . AIRPORT  
TERMINALS . . . ALL PUBLIC BUILDINGS

Low wattage incandescent lamps, both standard and tubular types, have long been popular. Small fluorescent lamps are also ideal for luminous signs, and colored lamps add to the effectiveness of the signs.



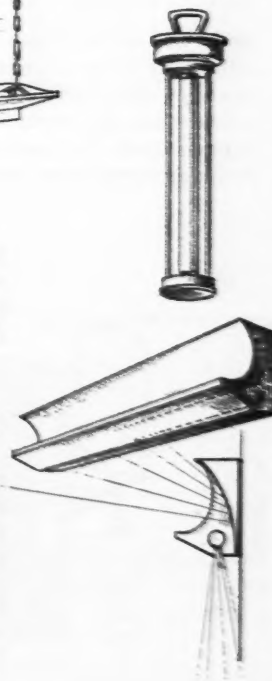
### GERMICIDAL EQUIPMENT

Reflector units for use with germicidal lamps are of many types. They are designed for air irradiation for improved public health, and for commercial and industrial irradiation.

#### *Sell these for Irradiating*

SCHOOLS . . . HOSPITALS . . . HOMES  
THEATRES . . . OFFICES . . . RESTAURANTS  
RETAIL ESTABLISHMENTS . . . POULTRY  
ANIMALS . . . MEATS AND PRODUCE

Units are available in a wide range of sizes, shapes, and methods of installing. Only a few typical types are illustrated



## Outdoor Lighting



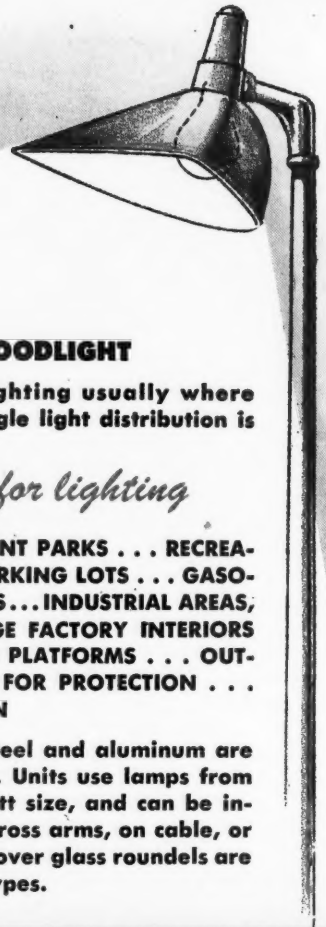
### STREET LIGHTING

One of many types of units designed to provide asymmetric light distribution for street and highway lighting.

*Sell these for lighting*

STREETS . . . HIGHWAYS . . . INDUSTRIAL YARDS . . . PROTECTIVE FENCES . . . PARKWAYS . . . PRIVATE ROADWAYS

Units are available for series and multiple circuits, for use with incandescent, mercury vapor and sodium vapor light sources, with reflectors, refractors, or plain diffusers for light control.



### OPEN FLOODLIGHT

For low cost floodlighting usually where medium and wide angle light distribution is required.

*Sell these for lighting*

SPORTS . . . AMUSEMENT PARKS . . . RECREATIONAL AREAS . . . PARKING LOTS . . . GASOLINE SERVICE STATIONS . . . INDUSTRIAL AREAS, OUTDOORS . . . LARGE FACTORY INTERIORS DOCKS . . . LOADING PLATFORMS . . . OUTDOOR STORAGE . . . FOR PROTECTION . . . NIGHT CONSTRUCTION

Porcelain enameled steel and aluminum are popular for reflectors. Units use lamps from 300 watt to 1500 watt size, and can be installed on pole tops, cross arms, on cable, or on side of buildings. Cover glass roundels are available for some types.

## RELIGHT AMERICA

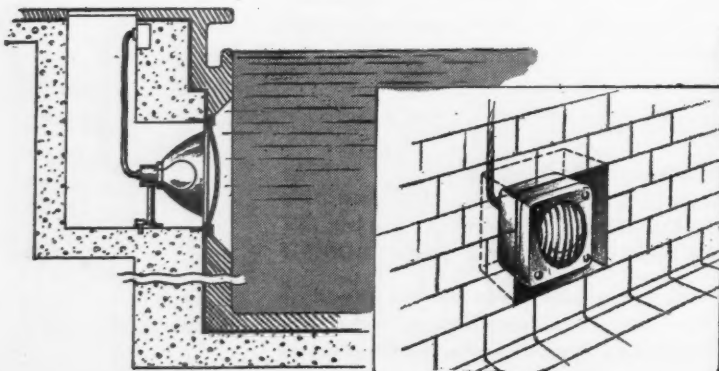
### SWIMMING POOL LIGHTING

Provides white or colored under water lighting for private or public swimming pools.

*Sell these for lighting*

PRIVATE SWIMMING POOLS . . . PUBLIC SWIMMING POOLS . . . TEST TANKS . . . FOUNTAINS . . . AQUARIUMS . . . FISH PONDS

Units are of two types—wet niche and dry niche. Wet niche type units may be immersed in water, as they are watertight. Dry niche type is a standard floodlight installed behind a gasketed glass plate or roundel. Manholes should be provided for servicing dry niche types outside the pool. Flexible rubber cable permits wet niche units to be removed from water for servicing.



### ENCLOSED FLOODLIGHTS

Equipped with separate reflectors for beam control, and cover glasses for protection against weather, diffusion, or change of shape of beam.

*Sell these for lighting*

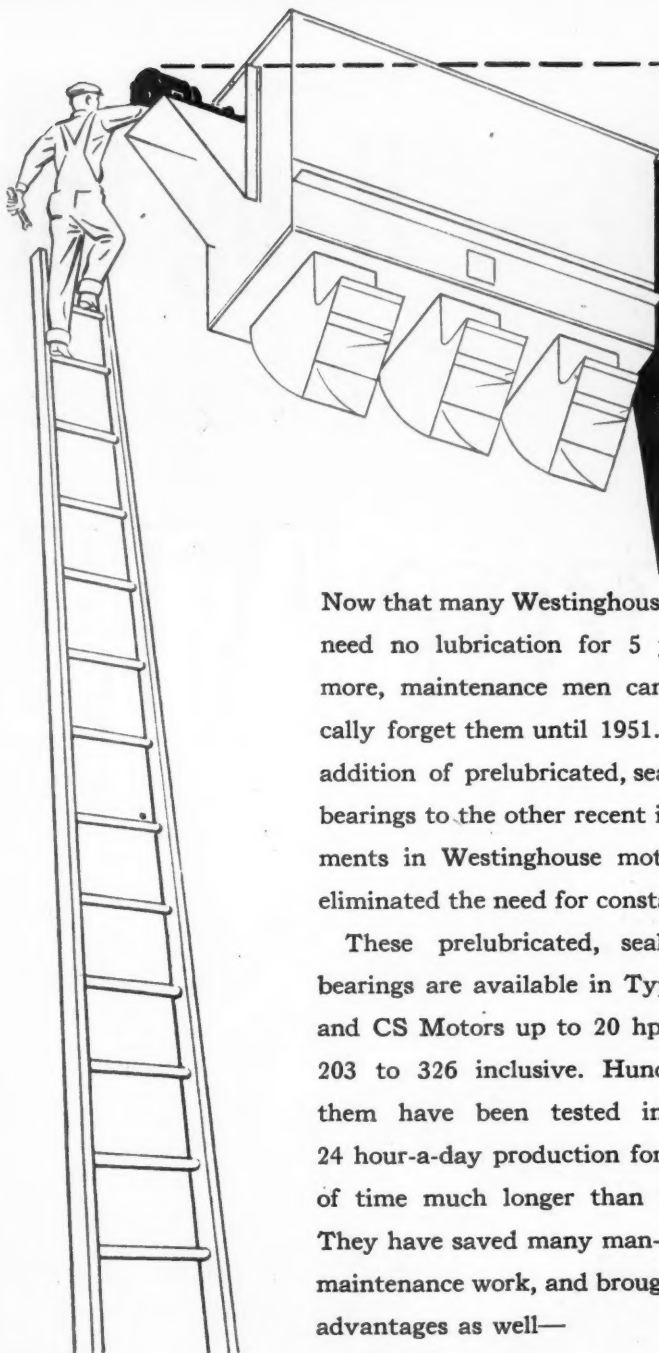
SPORTS . . . RECREATIONAL AREAS . . . PUBLIC BUILDING EXTERIORS . . . SWIMMING POOLS . . . MONUMENTS . . . LOADING PLATFORMS . . . OUTDOOR SIGNS . . . GARDENS . . . RAILROAD YARDS . . . AMUSEMENT PARKS . . . THEATRE FRONTS

Weatherproof and watertight construction permit units to be used outdoors in any mounting position. Designed for use with 200 watt to 1500 watt standard lamps, and round bulb floodlight lamps. Accessories include louvers, shields, colored glass roundels, diffusing and clear lenses, and rectangular beam lenses.





# INSTALL TODAY...



## DON'T LUBRICATE

*until 1951!*

Now that many Westinghouse motors need no lubrication for 5 years or more, maintenance men can practically forget them until 1951. For the addition of prelubricated, sealed ball bearings to the other recent improvements in Westinghouse motors, has eliminated the need for constant care.

These prelubricated, sealed ball bearings are available in Types CSP and CS Motors up to 20 hp, frames 203 to 326 inclusive. Hundreds of them have been tested in actual 24 hour-a-day production for periods of time much longer than 5 years. They have saved many man-hours of maintenance work, and brought other advantages as well—

- No overgreasing
- No "skipped" bearings
- No grease contamination
- No grease seepage
- No unreplaced pipe plugs

This freedom from frequent lubrication brings also a greater freedom to engineers designing new equipment or laying out plants. They can now place motors most advantageously for their operation—unhampered by questions of accessibility and ease of greasing. For further details, write for Bulletin B-3554 and Descriptive Bulletins 3100-CSP and 3100-CS-1, to Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pa.

J-21377

Until 1951, there's no need to have anyone climb a ladder to lubricate this motor.



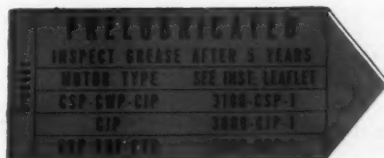
## Westinghouse

PLANTS IN 25 CITIES... OFFICES EVERYWHERE

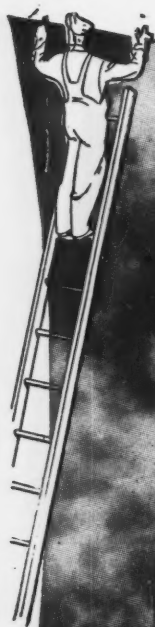


Prelubricated, sealed ball bearings are available in Types CSP and CS Motors up to 20 hp, frames 203 to 326 inclusive.

## *Squirrel Cage Motors*



Another Westinghouse "first"—this label identifies motors that you "don't lubricate for 5 years or more".



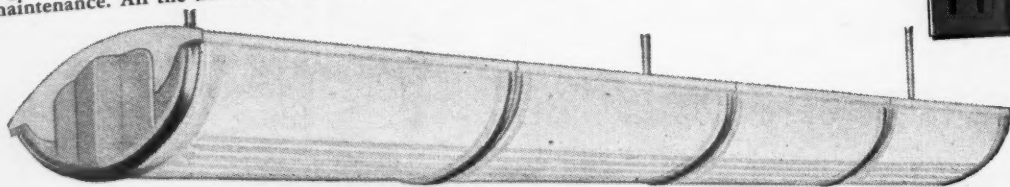
# NOW YOU CAN "Hang the *Wakefield* Over-ALL



## BRAND NEW...the Wakefield STAR

Modern in design... modern in construction and modern in lighting performance. Clinic-tested by lighting men all over the country, to assure you the best. Good lighting... simple, sturdy construction... easy maintenance. All the advantages of fluores-

cent, and of indirect light... plus proven PLASKON shielding. Brightness blended to the ceiling... provides a "sky" of eye-easy light. Unusually simple to handle and clean. An ideal tool for over-ALL lighting in office, school and drafting room... the STAR!



See it at the International Lighting Exposition, Hotel Stevens, Chicago, April 25th-30th.

**Sky** FOR BETTER SEEING!

*presents*

# Lighting



**... a new approach to commercial lighting that will help your customers ... build your business**

Over-ALL lighting by Wakefield supplies a new technique for lighting office interiors ... schools ... and drafting rooms. A method that means greater eyesight protection and greater comfort ... *and more business for you.*

Specifically designed to guard against eyestrain, the new Wakefield Over-ALL lighting method spreads soft, pleasing light ... *overall.* And we're confident that you and your customers will find this new system has it *over* all others for quality of light, cheerfulness and efficiency! Because Wakefield Over-ALL lighting is based on lighting *results at the working plane.*

In addition, it has been developed with an eye to your problems. For Wakefield Over-ALL lighting depends on lighting equipment that provides "top" lighting performance, easy installation, easy maintenance, and long-lasting service ... *in short, lighting equipment made by Wakefield.*

Ask us for the details. We'll be glad to show you how Wakefield Over-ALL lighting can work for your customers ... *and for you!* The F. W. Wakefield Brass Co., Vermilion, Ohio.

## Wakefield



ALSO THE GRENADE



THE ADMIRAL



THE COMMONWEALTH

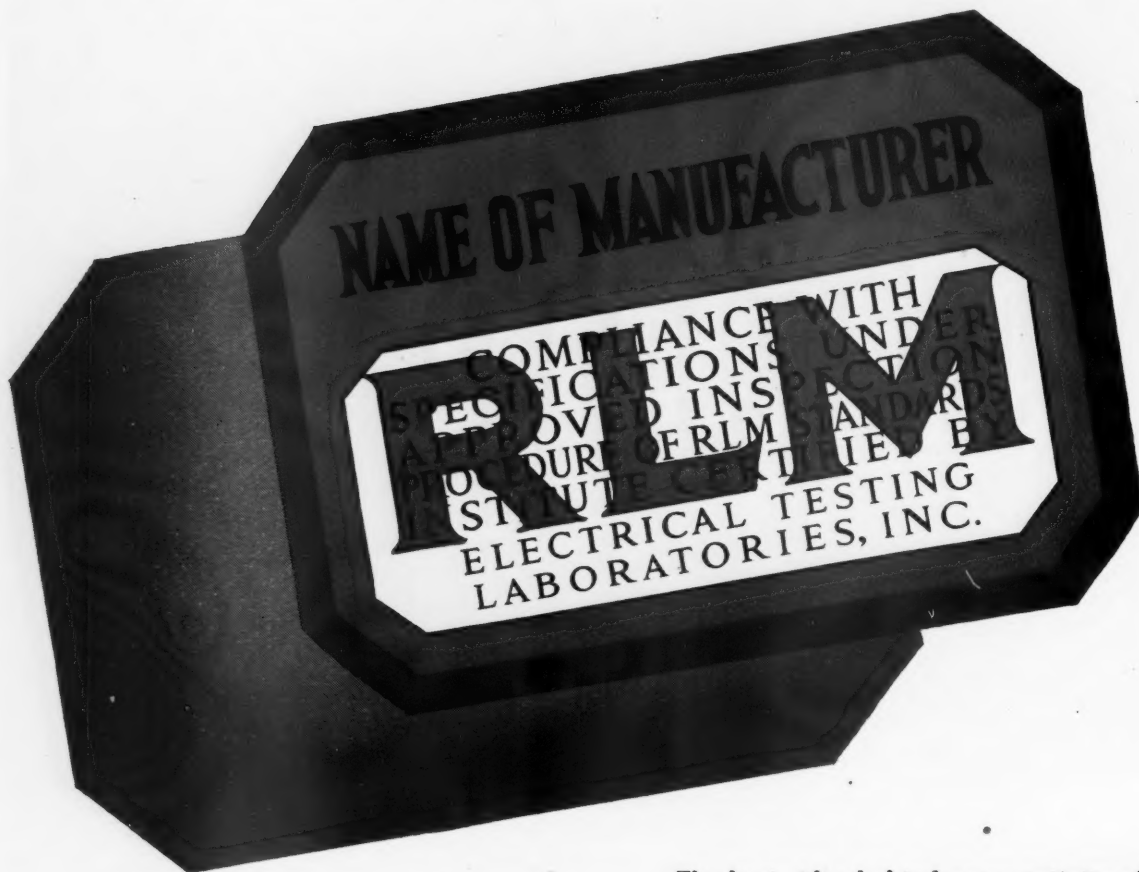


THE DIPLOMAT



AN OUTWARD SIGN OF

*Inner Value*



The basic idea behind every activity of RLM Standards Institute . . . and the use of the RLM LABEL to identify industrial lighting equipment certified by the Institute . . . is to protect the user.

Every industrial lighting unit qualified to bear the RLM LABEL must conform to rigid RLM Official Standard Specifications. These specifications cover construction and performance factors vital to safety, lighting efficiency and economy. Serving as a certificate of performance to these specifications, *certified by an independent testing laboratory*, the RLM LABEL is an outward sign of inner value.

That is why it is so worthwhile to look for the RLM LABEL when buying Incandescent and Fluorescent industrial lighting equipment.

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*The Letters RLM Stand for Reflector and Lighting Equipment Manufacturers*

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**BRIEF ARTICLES** about practical methods of installation and maintaining electrical wiring and equipment and up-to-date estimating and office practices. Readers are invited to contribute items from their experience to this department. All articles used will be paid for.

# PRACTICAL METHODS

## VAPOR PROOFING FLUORESCENT FIXTURES

—WIRING

Salvage and reuse of electrical equipment is an important item of electrical reconversion activities in the nation's industrial plants. With the wave of industrial strikes making the electrical equipment situation as bad or even worse than during the war years, the general order was for plant engineers to utilize whatever equipment happened to be in the building to get the new electrical systems in working condition. That, precisely, was the situation at the Kaiser-Frazer Willow Run plant now being converted from bomber to automotive production.

Among the usable electrical equipment items at Willow Run were some 400 vapor proof fluorescent fixtures. However, after four years of operation in a war plant, many of them were in a sorry condition, metal enclosures were damaged, felt gaskets were worn and torn, lamps and ballasts were burned out and some of the enclosing glass covers were damaged. Each unit had to undergo a complete inspection and reconditioning.

These salvaged lighting fixtures were to be utilized in the new paint spray booths being built for the car production lines at Kaiser-Frazer. It was important that they be rendered completely vapor proof. So the remodeling, done by the Turner Engineering Company, Detroit, electrical contractor on the project, got under way under the direct supervision of the Kaiser-Frazer engineering department.

First step in the rehabilitation procedure was the sorting of all the component parts of the fixtures. Metal enclosures were piled in one section, glass covers in another, and fixtures in still another section. The enclosures were then repaired—welded where necessary—and made vapor proof.

The vapor proofing of the 53-in. by 12-in. by 8-in. deep metal fixture enclosures involved the addition of a 1½-in. by 1½-in. angle-iron flange welded at the four corners and bolted to the outside of the box, flush with the top edge. This flange accommodates a ½-inch steel back-plate which completes the fixture enclosure and is used as a mounting plate for the unit. Just inside the flange, the box metal was bent inward to form a V with the angle-iron flange. This space was filled with a bead of Caulk



*Sponge rubber gasket is cemented to the angle-iron flange that has been added to the fixture enclosure. This is done after a Caulkite seal has been applied between the flange and enclosure.*

which, when hardened, created a seal between the fixture enclosure and the mounting flange.

To vapor proof the flange and back-plate, a ½-inch thick sponge rubber gasket, 1½-inches wide, was cemented to the top of the flange. The same treatment was applied to the bottom rim of the enclosure on which rested the glass cover. Here the worn out felt gasket was replaced with the sponge rubber one. With the enclosure thus completed, the fixture—having had its ballast and lamps tested—was bolted into place.

Since the fixtures were equipped with a three-wire, grounded, twist-tight plug and cord, electrical connection is made inside the vapor proof box. Thus, when a unit goes out, the six wing-nuts holding the enclosure to the back-plate are removed and the entire unit dropped down, the cord disconnected, and a new unit installed immediately. The back-plate remains mounted to the spray booth structure.

A complete seal between the fixture (with its plug connection) and the branch circuit conductors is provided



*Salvaged vapor proof fluorescent fixtures are disassembled and stacked for careful inspection before being remodeled and re-installed at the Kaiser-Frazer Willow Run plant.*

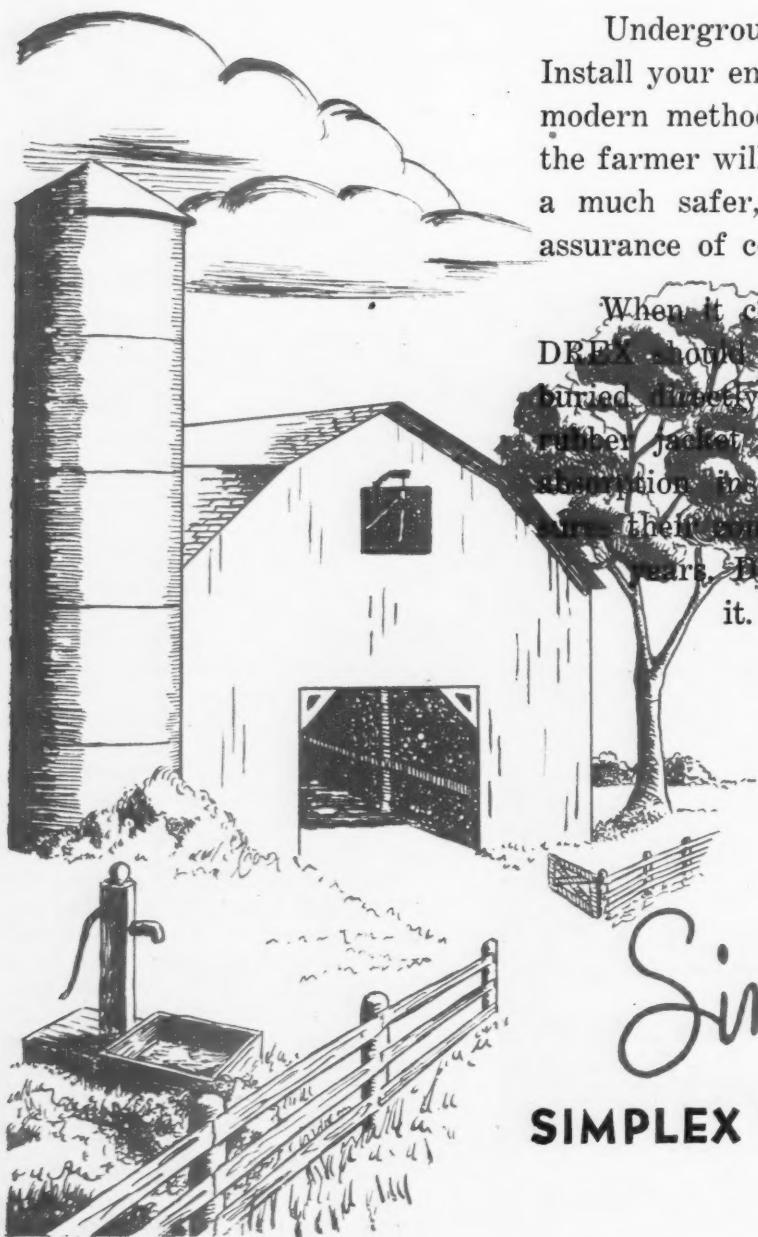
*Underground  
Cables make  
Farms Safer...*

With so many farms having electricity brought to their front door these days, you might just as well start the farmer off correctly by installing underground cables from the pole to the meter and from the meter to the various buildings to be supplied with power.

Overhead cables of any kind are dangerous around a farm. It is customary to install a pole in the farmyard and run the entrance wires to it and radiate the wires to the various buildings from it. A wagonload of hay with a fork sticking out on top could easily wreck one or all of these wires, perhaps even setting fire to the load of hay and creating a dangerous fire hazard in the farmyard, which is usually the center of all buildings.

Underground cable costs only a few cents more. Install your entrance cables and feeder cables in the modern method. You will have a finer looking job, the farmer will be better satisfied, and you will have a much safer, more satisfactory installation with assurance of continuity of service.

When it comes to underground cables, ANHYDREX should be your natural choice. They can be buried directly in the ground. They have a tough, rubber jacket that resists abrasion. The low water absorption insulation on ANHYDREX cables assures their continual operation for a long period of years. Do the job right when you are doing it. Put all the cables underground and use ANHYDREX when you do it.

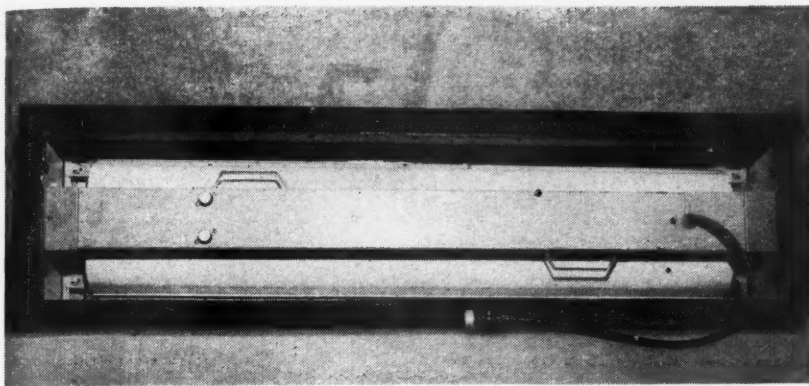


*Simplex-Anhydrex*

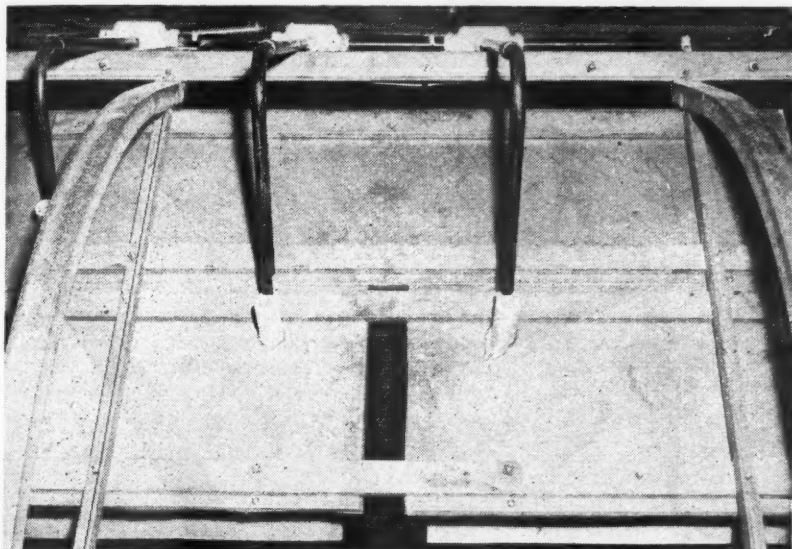
**SIMPLEX WIRE AND CABLE CO.  
79 SIDNEY STREET  
CAMBRIDGE 39, MASS.**

*Electrical Contracting, April 1946*

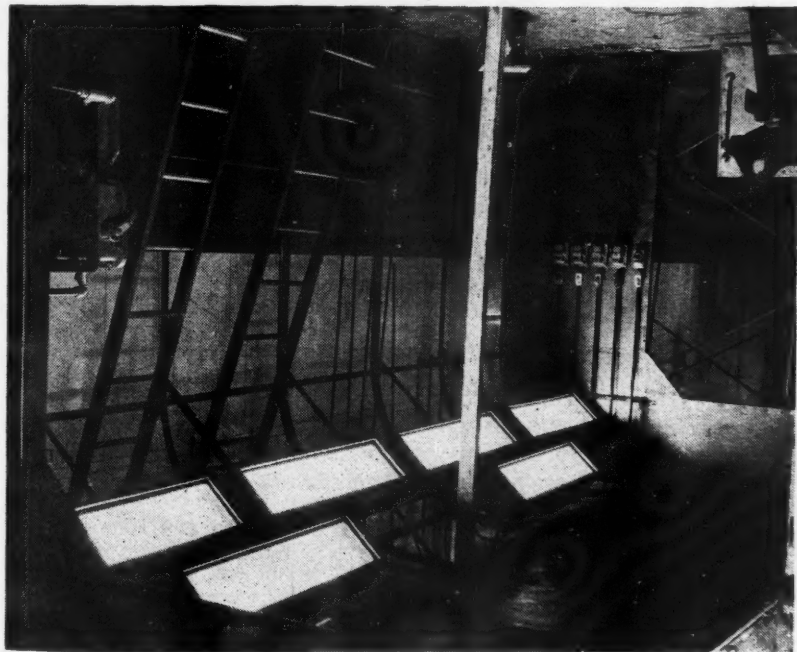




*The gasketed enclosure with the fluorescent fixture installed. Note disconnecting cord for electrical connection inside the fixture enclosure.*



*Circuit connections are made through explosion-proof sealing fittings threaded into back-plate of fixtures mounted to spray booth housing.*



*Each spray booth has six fixtures mounted at 45 degree angle on open side of booth. With water wash opposite and adequate ventilation, concentrations of explosive mixtures are unlikely. Note explosion-proof control switches inside booth enclosure.*

by the installation of a conduit sealing fitting threaded into the mounting plate of the fixture enclosure. Conduit extensions go from this fitting to vapor proof fittings in the circuit conduit at the top of the booth. Here the fixture cord is spliced to the circuit conductors.

The paint spray booths being installed at Kaiser-Frazer are of the semi-enclosed type, one side (the water wash) and most of the top being closed; the other side (where the operator stands) having only about a 4-ft. high enclosure, the rest being open. The lighting units are installed along the "open" side of the booth, at a 45 degree angle near the top. A total of six, two-lamp, 40-watt, daylight fluorescent fixtures are installed in a double row (four on the bottom and two on the top) in each booth which is 10-ft., 6-in. high and 14-ft. wide. In addition, two additional units are installed at the base of each of the two corners of the booth, on either side of the operators. This is done to eliminate shadows. All lighting units are controlled by explosion-proof switches inside the booth, as are pump motors and other electrical equipment.

The spray booths are installed in groups of two (tandem fashion) along the production line. As the car passes into one booth, one half is sprayed; in the adjacent booth the other half is painted.

Since the fixtures are mounted on the "open" sides of the booths and all excess paint and fumes are drawn by forced draft into the water wash, there is little chance of an explosive mixture accumulating. And the steel mounting plate together with the fixture enclosure provide sufficient surface to adequately dissipate any heat that may be generated by the fluorescent lamps and auxiliaries.

## **MOTORIZED HAND TRUCKS CUT COSTS**

**INDUSTRIAL**

The use of electric propelled hand trucks has achieved a 46 percent reduction in handling charges at the factory of the Line Material Company, Milwaukee, Wis. Low maintenance of equipment, increased safety in operation, greater speed of handling and superior performance in loading have also been realized.

In the manufacture of electrical distribution, transmission and street lighting equipment, the Line Company produces approximately 500 tons of finished products monthly. Each piece of raw material is handled from three to five times before it emerges as a finished electrical product, resulting in an actual

draw this label into  
**YOUR** testing plan



**be sure with FLEUR-O-LIER**

**I**N every modernization plan, lighting is a vitally important factor. But vital, too, is the necessity for a carefully planned lighting layout...intelligent selection of the proper lighting fixtures. The way to be sure of the right fixtures is to specify those wearing the famous FLEUR-O-LIER Label of Certification. That means electrical and mechanical excellence, top lighting performance, trouble-free operation, fewer service worries.

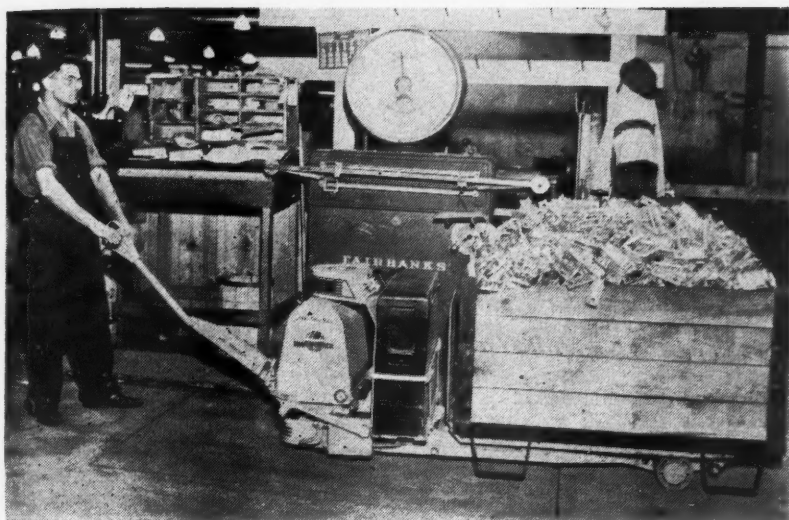
Fixtures wearing this label are made by over 30 leading manufacturers participating in the FLEUR-O-LIER testing and certification program. Thus . . . to the integrity and reputation of the individual manufacturers is added the *protection* of the FLEUR-O-LIER Label . . . double assurance of superior value and satisfaction. Can you afford to let your customers be satisfied with anything less?

*All certified FLEUR-O-LIER fixtures are equipped with Certified Ballasts and Starters, additional assurance of better service from the Lamps you use.*

## **FLEUR-O-LIER** *Manufacturers*

Fleur-O-Lier is not the name of an individual manufacturer, but of a group of more than 30 leading fixture manufacturers. Participation in the FLEUR-O-LIER MANUFACTURERS' program is open to any manufacturer who complies with FLEUR-O-LIER requirements.





**A 6,000-pound load rolls over the scale, moved by the self-contained power of a battery-powered automatic transporter. Man-hours for handling 25,000 tons of material by electrical means is 20 percent of the former total required for hand-powered movement.**

average movement of over 25,000 ton of materials annually.

Prior to the introduction of automatic handling equipment, the bulk of this handling and movement of both unfinished and finished goods was done with conventional two-wheel hand-operated lift trucks. To accomplish the task 30 men were employed constantly.

Six men, operating six Automatic Transportation Company transporters, now perform the same volume of work. Pressure on a button motivates the battery-powered motor and forward or reverse motion can likewise be dictated through hand pressure. Inclined ramps in the plant, some up to 14 percent in inclination, formerly necessitated the assistance from additional men and are now mounted by the self-powered machines. Injuries from strains have been practically eliminated.

Handling costs have dropped from 74 to 40 cents per productive hour, a gross saving of over \$1,000 a month. Over a period of 30 months, the cost of maintenance has averaged less than four dollars per month per machine.

The productive abilities of the 24 men released from handling duties have been re-employed in other steps of production.

## WIRING GENERAL AND DEPARTMENT STORES

INDUSTRIAL

Present day merchandising is Big Business and the modern, progressive department or general store is subscribing to the economically sound wisdom of offering the buying public not only goods but also conveniences and courtesies in pleasant and restful surroundings.

Checkrooms relieve one of the tiring burden of coats and bundles, restaurants and tea rooms offer the shoppers both food and rest, storewide musical broadcasts are carefully selected and we occasionally find nurseries to care for children while mothers shop; little theatres where free demonstrations of equipment, fashion shows and other sales-sponsoring attractions are staged in conjunction with lectures and musical programs; photographic studios; beauty shops; garages; cleaning and tailoring departments. The modern store is competing with the amusement and civic centers as well as with many diversified interests not connected with merchandising.

With this progressive mental attitude and wider scope, the uses for electricity have multiplied proportionately and contractors are receiving orders to install

up-to-date wiring and lighting under three main classifications: new installations in both new and old buildings, extending existing electrical plans and revamping inadequate or obsolete systems. Throughout the country stores are changing from a-c to d-c, stepping up voltages, replacing or augmenting incandescent illumination with fluorescence, rewiring with thin wall insulated conductors to increase the capacity of existing ducts, changing elevators from car switch or hydraulic to full-automatic, self leveling, pushbutton operation and installing escalators to present store panoramic views while providing vertical transportation. Heavier and more numerous circuits are required for special lighting treatments using higher intensities of illumination, demonstrating power tools or electric ranges, operating signs and displays in windows, over counters and on roofs and motivating elevators as well as for contemplated changes and additions which undoubtedly will materialize in the near future.

To centralize the distribution center the electrical problem first becomes one of working out departmental requirements and secondly designing the mechanical layout so that the service entrance is as close as possible to the center of load. Subfeeders should be sized with voltage drop and future demands in mind. Protective devices and controls should be provided for each current carrying device.

It is obvious that each department or general store has so many variables that universal criteria is impossible. The check list will aid as a suggestive reminder in planning a wiring layout but intimate knowledge of the individual sectional components, traffic loads on both freight and passenger elevators, lighting demands and contemplated conveniences and services is the only sure method to accomplish complete coverage.

### WIRING CHECK LIST FOR DEPARTMENT AND GENERAL STORES

Adding Machines	Illumination—signs	Vacuum Cleaners
Advertising Specialties	Irons	Window Displays—electrical
Air Compressors	Kitchen Apparatus—demonstration	
Pneumatic Tubes	Loading equipment	Signal systems
Cash Carriers	Multigraphing machines	
Cash Registers	Ozonators	Elevator annunciators
Cigar Lighters	Package conveyors	Floor walker call bells
Conveyors	Photographic equipment	Fire alarm
Dishwashers	Powered tools	Telephones
Duplicating typewriters	Radiators	
Dryers—Beauty shop	Ranges	
Dye heaters	Refrigeration—furs and food	
Elevators	Repair shop apparatus	Illumination—recommended intensities in footcandles
Escalators	Radios	
Fans—ventilating	Sewing machines	Aisles 10—30
Floor cleaning machines	Silver burnishing machines	Counters 30—90
Fountains	Soldering Irons	Showcases 50—150
Glue pots	Sterilizers	Special displays 100—300
Hot plates	Trucks	
Illumination—general and special		



**HERE'S**

**NEW**  
**for**



**4 Fact-Packed Meetings  
show how to  
capitalize on  
Modern Sales Lighting**

**OPENING MEETING:** Why should the Electrical Contractor aggressively go after the Store Lighting Business?

**SECOND MEETING:** What is Sales Lighting? New Lamps and Fixtures for the Storeowner. Movie: "The Magic of Fluorescence." The 3 A's of Store Lighting.

**THIRD MEETING:** How to Specify, Maintain and Finance Sales Lighting. A Practical Lighting Maintenance Service.

**FINAL MEETING:** How To Sell Sales Lighting. Why the Storeowner Buys. Demonstrations. How to use LaSalle Sales Training.

# HELP contractors

## G-E COORDINATED STORE LIGHTING PROGRAM READY NOW!

**H**ERE'S a powerful force to help you find, develop and close more profitable sales of commercial lighting. It's a broad, inclusive, fast-moving program developed by General Electric to help you cash in on the tremendous store lighting business that exists NOW.

Key to the new program is a complete series of four local meetings packed with ready-to-use, up-to-date tools and techniques that give you all the facts on:

1. How best to locate and develop prospects and meet their individual needs using modern lighting tools, and
2. Proved ways to get more and better profits from

lighting jobs and realize your share of today's huge store lighting market.

Each meeting—featuring movies, sound-slide films, charts, skits and dozens of other war-proved methods of making graphic and convincing demonstrations—will prove how lighting can best be specified, sold and installed; how costs can be minimized; shortcuts to more and better lighting profits; and a wide range of new and improved sales practices.

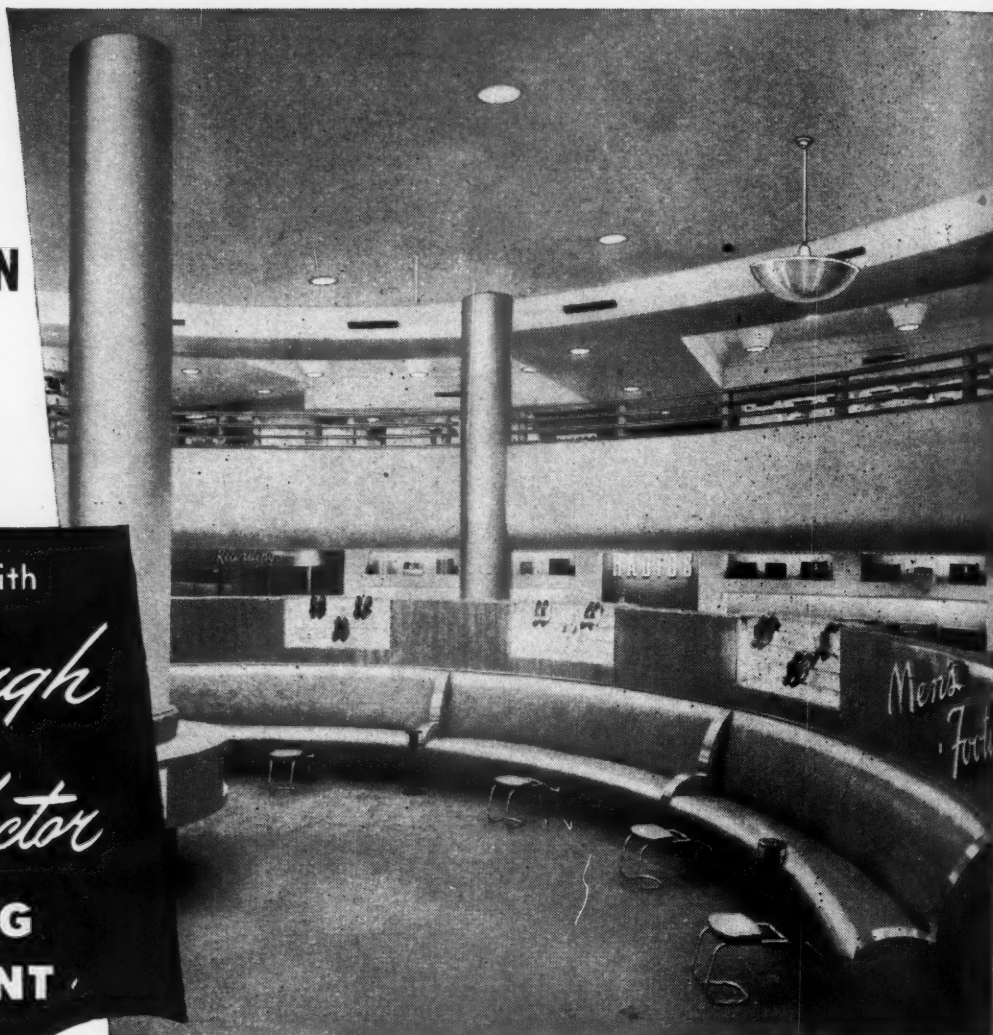
**DON'T DELAY.** Call your G-E Lamp Representative for full information about the G-E Coordinated Store Lighting Program. It's the most complete, most practical program of its kind ever offered... call today.

Visit the International  
Lighting Exposition,  
Hotel Stevens, Chicago,  
April 25th through  
April 30th.  
See the G-E display,  
booth nos. 27-32 inclusive.

A black and white advertisement graphic for G-E lamps. It features a dark rectangular background. At the top, the words "G-E LAMPS" are written in large, bold, white sans-serif capital letters. Below this, the words "GENERAL ELECTRIC" are written in a smaller, white, stylized font, with a small circle between the words. In the center, there is an illustration of a GE lamp box, a standard incandescent bulb, and a fluorescent tube. To the right of the illustration, the phrase "Stay Brighter Longer!" is written in a large, white, cursive script. The entire graphic is tilted slightly to the right.

**G-E LAMPS**  
GENERAL ELECTRIC  
*Stay Brighter  
Longer!*

**LIGHT  
MODERNIZATION**  
*at its  
Finest*



**"Something Better Has  
Come to Light!"**

**INCANDESCENT:**

Show Window Permaflexors •  
Recessed Ceiling Units • Indi-  
rect Permaflexors • Luminaires •  
Spotlights • Floodlights • Stage  
Lights • Accessories.

**FLUORESCENT:**

The Presidential Luminaires for  
pendant or surface mounting •  
Recessed Troffers • Strips • Ac-  
cessories

**P**ITTSBURGH PERMAFLECTORS are selected for this, and thousands of other outstanding installations, because they offer the right combination of lighting equipment to meet *all design and use requirements* for efficient and effective illumination. Electrical contractors and wholesalers can offer their customers this prestige line with full confidence that they are selling quality lighting equipment.

The Pittsburgh Reflector Company has taken long strides forward to make it easier for you to make money with *Pittsburgh Permaflexor* Lighting Equipment. *Pittsburgh Permaflexor* Equipment has many time-tested and sales-making factors . . . plus fine engineering, materials and construction.

The flexibility of application, ease of installation and maintenance, and long service life of *Pittsburgh Permaflexor* Equipment has gained it consumer acceptance. You profit by this through bigger sales and satisfied customers when you recommend *Pittsburgh Permaflexor* Fluorescent and Incandescent Lighting Equipment.





## REEL ROLLER FOR HEAVY CABLE PAY-OUT

SHOP

Cutting heavy cables to required job lengths is no longer a chore at the Electric Service Company, Ann Arbor, Mich. electrical contracting firm. Back in one corner of the large stockroom is a simple roller device designed by B. Tindall, owner of the company. Now, one man can unreel and cut large diameter cables with little effort. Cumber-some reel-jacks are a forgotten item.

Made from scrap materials, the reel-roller consists of two 31-inch lengths of 3-inch angle iron securely fastened to the concrete floor, 36 inches apart. Mounted to the vertical leg of each angle are five 2-in. diameter ball bearings. The first two (near the center of the angle) are on 14-inch centers; the others on 4-inch centers. Each group of four bearings—two on each angle—accommodates a roller fashioned from a 36-inch length of 3½-inch pipe.

Normally, the rollers rest on the "front" two sets of bearings. For larger diameter reels, the rear roller is moved back four inches to the second set of bearings. The front roller remains in position. An inclined ramp of wood is built in front of the device so the heavy reels can be easily pushed on to the rollers.

The free rotation of the pipe rollers on the ball bearings reduces the "pull" and prevents the reel from "jumping" when the cable is unwound. A hole drilled in the front roller permits the insertion of a bolt "stop" to prevent rotation when the reel is backed off the device.

The reel-roller faces a long stock-

room aisle which permits a long, free, pull when unreeling the cable. The concrete floor becomes a huge tape-measure with 10-ft. graduations clearly painted on the surface.

Many are the hours of back-breaking labor that this simple device has saved the Electric Service Company, according to Mr. Tindall.

## SLANTING RACKS AND NARROW TRUCKS ARE STOCKROOM AIDS

INDUSTRIAL

What formerly served as a reinforced concrete ice house in Easton, Pennsylvania, has been completely renovated for H. N. Crowder Jr. who, by adding this 30,000 square feet of floor area, augments the facilities of the crowded shops and office space in the Allentown plant. Modern loading facilities, shop layout, safety features, lighting and storage arrangements have been incorporated in the design.

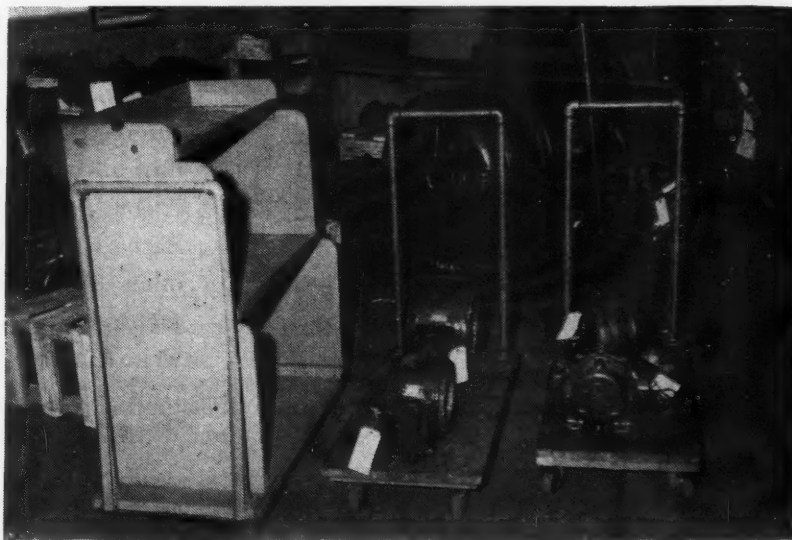
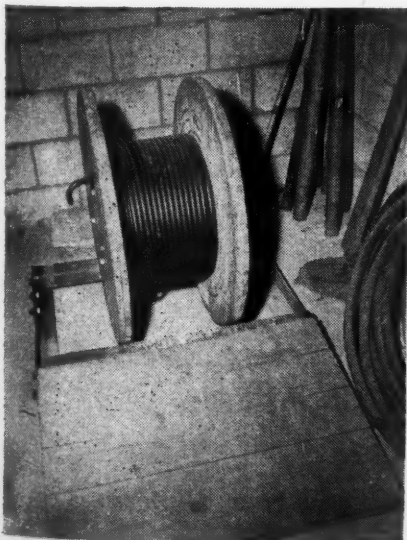
Adjacent to the main entrance, placed to one side of the waist-high filing cases which outline the office space and act as counter work areas, a display exhibit presents a selected variety of material and tools used in the trade. Behind and to the right of the banked displays, extending from the floor to the level of the continuous suspended fluorescent RLM lighting fixtures, are racks used to store V-beltting, Fig. 1. Since continuous beltting varies in loop length, the racks are erected at an angle to the horizontal, permitting the loops to hang freely without becoming tangled with belts hanging

from a lower tier of steel pegs. Unobstructed visibility of stock is obtained, the appearance of the combination display-stockrack is improved and space is conserved.

Another idea is the stockroom method for storing or selecting materials. Dollies, mobile shelves, racks and bins were designed with a narrow width, allowing these rubber-castered trucks to be wheeled between the shelves and racks located in the stock area, Fig. 2. Multiple trips between stockroom and shipping platform or shop are eliminated through the ability of carrying more material per trip and strains caused



**FIG. 1—Belting of unequal length hangs freely from slanting, pegged stock racks. The inclination conserves space, makes a more attractive display and prevents tangling of the belts. Continuous suspended lighting fixtures throw light on rack and also on display area to left.**



**FIG. 2—Narrow gauge trucks are designed to permit their passage between the shelves of the stockroom. Motors and heavy boxes are placed directly on the dolly platforms and shelves or bins are constructed to hold smaller cases or loose material. Rubber casters and pivoting, ball bearing wheels promote silent and easily directed movement.**

Two pipe rollers on free-action, ball-bearing, mounts facilitates unreeling of heavy cables. Dual adjustment of rollers accommodates larger reels. With this device, one man can unreel and cut large cables with little difficulty.



## ... for Lighting Men in 1940

When New York's Belt Parkway blazed into brilliance in 1940, it made lighting news. Here was the longest stretch of sodium-lighted highway in America—a full 33 miles of it! The light of 2200 sodium lamps, developed by G.E., being reflected by Alzak\* Aluminum Reflectors, with a brilliance that gave night drivers on this famous highway the high visibility shown at left.



## ... for Lighting Men in 1946

1940's news has become a lesson for 1946. For the Belt Parkway skirts a lot of salt water. Smoke and fumes are ever-present. Yet five years' exposure has made no appreciable difference in the efficiency of these reflectors.

The advantages of Alcoa Aluminum reflector sheet in Alzak and other finishes are musts for your data book. Easy formability—unshackled design. High efficiency—for incandescent, fluorescent or radiant applications. All the durability that characterizes corrosion-resistant Alcoa Aluminum, and the special finishes Alcoa has pioneered. Suggest Alzak finish or other Alcoa finishes to your reflector manufacturer. Consult our nearest sales office, or write ALUMINUM COMPANY OF AMERICA, 1946 Gulf Building, Pittsburgh 19, Pennsylvania.

\*Registered Trademark

# ALCOA ALUMINUM





from lifting heavy loads are minimized through the use of chain hoists in shipping room and warehouse. An overhead monorail extends through the doorway of the shipping room and runs over the parking area, permitting motors and boxes of material to be lifted from delivery trucks by chain hoists and run directly into the interior checking area where they are lowered to the narrow gauge stockroom dollies. The simplicity of truck construction makes it feasible to duplicate them in any shop. Inch diameter galvanized pipe and elbows form the framework for the pushing and steering bar. Pipe uprights are fastened to the platform with round mounting collars and angle iron struts welded 18 inches above the platform serve as braces. Caster bases are screwed to the heavy plank base platforms. Monorails also run above the stockroom aisles and, after rolling the trucks between the storage shelves for unloading, chain hoists raise the loads to shelving levels. In transferring material from stock shelves to shop, the mobile bins or shelves can be used as supply benches and rehandling time is avoided.

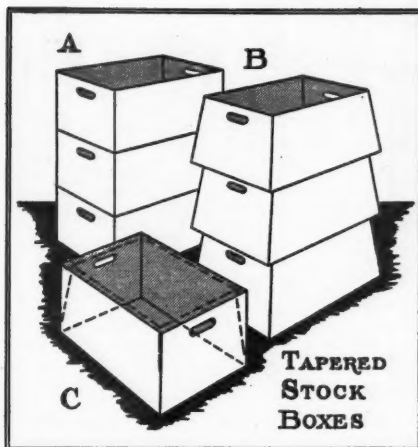
## TAPERED STOCK BOXES ARE SAFETY FEATURE

INDUSTRIAL

Metal boxes are used extensively in shops for segregating stock items, storing tools, retaining parts of a disassembled motor or issuing materials required for a specific job. The usual box is of sturdy sheet steel with handles in the upper portion of the end sections and with sides perpendicular to the base and at right angles to the adjacent sides. (Sketch A.)

Boxes are stacked in tiers to conserve floor space and, when top and bottom areas have the exact dimensions, boxes or baskets have to be stacked in perfect alignment to secure adequate and solid bearing. Speed in stacking can result in an uneven, off-center, unbalanced condition or jarring by moving hand trucks can cause a similar condition. Since three or more cubic feet of motor parts or stock items can weigh several hundred pounds, upsetting a tier of steel baskets becomes not only a time-consuming, housekeeping item of re-stacking but a potential source for industrial accidents and a resultant loss of man-hours of production.

Stock boxes used in the repair shop and storage department of the S. J. O'Brien Corporation, New York City, are manufactured with a slight taper running inward from bottom to top. Longitudinal and transverse dimensions



*Standard, right-angle construction requires exact alignment to secure adequate bearing and stack sturdiness (A). Tapered boxes offer firm base for higher basket (B). Top dimensions of tapered box are slightly less than bottom width and length (C).*

across the tops are slightly less than the corresponding lengths and widths of the bottoms. (Sketch C.)

When stacking these boxes, a firm bearing area is assured, the tier is neat in appearance, safety is improved and workmen have the choice of lifting the boxes from the bottoms or by the handles. The slight recess at each stacking level (Sketch B) facilitates moving and piling without the danger of bruised fingers or broken toes.

## HINTS FOR ELECTRIC TOOL USERS

TOOLS

Wiring installations frequently demand that conduits and feeders be carried through concrete flooring and wooden partitions and that overhead holes be drilled for hangars. The Wodack Electric Tool Corporation of Chicago offers several helpful hints for electrical men using power drills, hammers or other electric tools.

To prevent binding of a drill when boring wood, a twist drill should be used. If it is necessary to use an auger bit with an electric drill, the threads on the screw should be filed off. The threads are for the purpose of pulling the drill into the wood which makes hand drilling easier. If used with an electric drill, the threads pull the drill into the wood too fast and either the drill will stall or the wood will split. When boring with an electric drill the feed should be controlled entirely by the operator, which is possible if the threads on the screw feed tip are filed smooth. The tip itself should be left as a guide in starting the holes. Ordinary square

shank bits can be used in electric drills by cutting off the square shank.

When drilling holes in a concrete ceiling the weight of the drill can be carried by the worker's shoulders instead of by his arms if the theory of the color bearer is employed. All are familiar with the flag bearer in a parade who carries the load of the pole in a pocket on a belt supported from the shoulders. The same kind of belt has been used to support an electric hammer being used in an upright position.

General hints for electric tool users should also be useful. Among these tips we find the following:

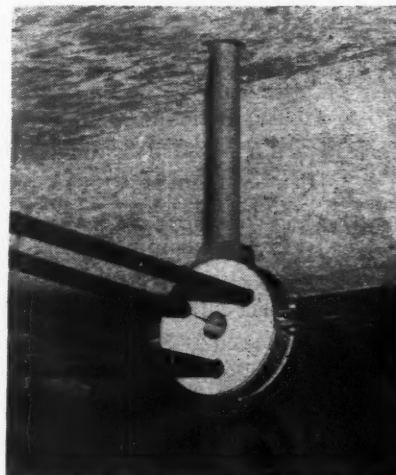
Give each tool a thorough inspection, cleaning and lubrication at regular intervals depending on the severity of service.

Most frequent trouble is with extension wires. Do not yank cords to pull plugs from sockets, pull or lift tools by cables, hang tools from cable, run trucks over cables, neglect to repair a break in the cable or cut off the damaged section.

Keep plug in good condition. Keep switches clean and lubricate if necessary with light oil.

Inspect carbon brushes often. New brushes are far cheaper than commutators and armatures. Use genuine parts. Replace brushes when worn between a quarter and a half of their original length.

Clean commutators with fine sand paper when necessary. A running spark around the commutator when tool is in use is an indication of open coil in the armature.



*Anti-sway support for open wiring installation under carborizing furnaces at Dodge-Chicago Plant, Division of Chrysler Corporation. An 11-inch length of 1 1/4-inch conduit over the rod supporting the split porcelain insulator ring acts as a spacer—so wiring will clear bottom of concrete beam—as well as a stabilizer against swaying.*





As shown by these data sheets from Sweet's\*  
there are life-time Porcelain Enamel

## BENJAMIN LIGHTING UNITS

for all industrial lighting requirements

May we send you a complimentary copy of this four page Lighting Data Bulletin on Benjamin Equipment as found in the new 1946 editions of Sweet's Catalog\*?

This Bulletin provides you with a valuable quick picture of the many different types of lighting units that are required to meet properly the many plant lighting needs. You will find in this Bulletin not only assistance in determining the types of lighting you wish to check into further, but also the evident importance of specifying from a complete line, such as is Benjamin's, to assure the best possible lighting results. Evident, too, will be the value of insisting upon porcelain enameled reflec-

tors, Benjamin Life-time porcelain enamel, for lower maintenance costs and longer life.

For your copy, please write The Benjamin Electric Manufacturing Company, Dept. H, Des Plaines, Illinois.

**BENJAMIN**  
TRADE MARK  
*Lighting Equipment*  
FLUORESCENT ... INCANDESCENT ... MERCURY VAPOR  
... EXPLOSION AND VAPOR-PROOF ... FLOODLIGHTS

Distributed Exclusively through Electrical Wholesalers



\*Architectural and Engineering Sections

at the International Lighting Exposition, Chicago, Apr. 25-30

First Showings of the NEW BENJAMIN FLUORESCENT LIGHTING UNITS  
for Industrial Locations and Offices; featuring new developments in lampholders, shielding, trouble-free auxiliary equipment, new styling, and other advancements.

1675

# INDUSTRIAL ELECTRIFICATION

ENGINEERING • INSTALLATION • MAINTENANCE

## How to Select Controls—I

First of a series on the selection and application of electrical control apparatus.

A motor starter does more than start and stop a motor. It starts and stops it in a specific manner, at the right time, and it protects the motor against damaging overloads. Starters fall into two general classifications, manual and magnetic—the latter sometimes being known as automatic, although this term is more generally reserved for a type of control. The choice between a manual or magnetic starter depends on the application of the motor and the desired method of control.

### Manual Starter Application

The manual starter is a hand operated switch, equipped with overload relays. The motor is started and stopped by moving the switch. In the case of an overload on the motor the starter will trip off before the motor is damaged, and it is necessary to throw the switch on again to restart the motor.

Strictly speaking any hand operated starting device is a "manual" starter, but the term is generally used to refer to single position switches which throw a motor directly across the line. This would exempt the starting box for a d-c motor, which falls under the classification of a reduced voltage starter, manually operated. In general only fractional horsepower d-c motors are started by placing them across the line, although the size of the motor which can be safely started by this method depends somewhat on the nature of the driven load. With a-c much larger motors can be started this way.

Manual control is most suitable for small motors, such as grinders, exhaust fans, and various tools, the control being located close to the motor, and the motor

By **Richard Pitt Ballou**  
Chief Engineer  
Federal Electrical Products Co.

close to the machine it drives. Manual starters are also used to supplement the automatic control of motors, the automatic control being by means of a float or pressure switch, or thermostat and contactor, or some similar device, the purpose of the manual starter being to afford overload protection to the motor while it is running, and to definitely disconnect it at the end of the day or other operating period. Typical applications would be on an air conditioning unit for a small office, and on oil burners and air pumps installed in garages and gasoline filling stations.

One advantage of the manual starter over the magnetic is the lower cost. The manual starter itself costs less than the magnetic, and it may be used without any additional branch circuit disconnecting means if it is properly constructed. Circuit protection is required, the same as with a magnetic starter.

While the manual starter has many uses, it is strictly limited in its scope. Two important features should be noted: (1) It cannot be started from a distance, nor controlled by automatic means, and (2) in case of a voltage failure the starter remains on and the motor starts again when the power returns. This second feature is sometimes a desirable one, and can be obtained on magnetic starters by using 2-wire control; however, there are many machines on which it is a distinct disadvantage, sometimes a positive danger: to the operator, the load, or the machine. In such cases the manual starter should not be used—in its place there should be used a magnetic

starter with 3-wire control which affords "no-voltage" protection; then after a voltage failure the machine can only be restarted at the definite instigation of the operator.

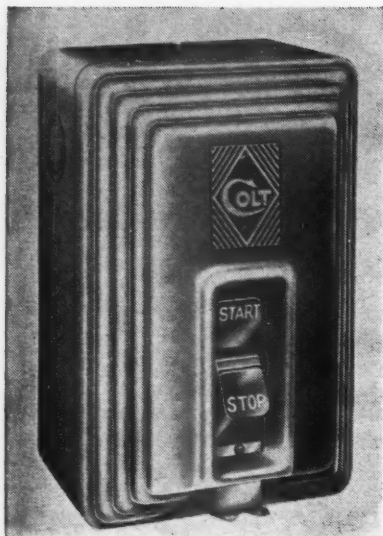
### Magnetic Starter Application

The magnetic starter is a magnetically operated switch equipped with overload relays. Without the relays it is known as a "contactor". Contactors may be a-c or d-c, or they may even operate with a-c to switch d-c, or *vice versa*. Except in the smaller sizes, d-c motors are seldom thrown directly across the line by a magnetic starter—they are either started by a hand operated starting box, or by an automatic (magnetic) starter that incorporates at least one step of resistance. The "magnetic starter" generally places a-c motors directly across the line. It is frequently called an "automatic starter" because of the fact that it is suitable for automatic control.

In the magnetic starter the main motor circuit contacts are closed by means of an electro-magnet, the magnet circuit being closed by a pushbutton station or other hand operated master switch, or by automatic means such as a thermostat, pressure switch, or time clock. Several pushbutton stations may be used if desired, and in series with any type of control there may be placed safety switches.

Magnetic starters are used on many small motors, and on practically all large ones. They allow automatic control, remote control, control from two or more locations, safety switch protection, low-voltage release, no-voltage protection, and automatic recycling with certain types of overload relays. The contactors have the same features as the





**Manual starter in general purpose enclosure.**

starters, without the overload protection. A few of the applications are—stokers, conveyors, pumps of all kinds, machine tools, motor-generator sets, ventilators, compressors, door openers, refrigeration machinery, sign flashers and displays.

Magnetic starters are made in a variety of combinations to allow exactly the right type of control and the starter should be selected on this basis. Certain types of control are built into the starter itself; others are obtained by the proper circuit arrangement and external control device. The terms most germane to the starter itself are:

**Common Control and Separate Control.** These refer to the source of the voltage used on the magnet coil. Conventional starters are usually wired "common control"—the same source of voltage on the motor and the coil. However, they are usually arranged to be quickly reconnected to use a separate power supply on the coil of the same or different voltage.

**Remote control.** A pushbutton or other suitable control station must be used, and it is the usual type for use with automatic control.

**Local Control.** A 3-wire pushbutton station is mounted in the cover. One or more 3-wire stations may be added elsewhere if desired, or one or more 2-wire safety switches may be connected in the circuit. This form of control is very common on small starters, and is gradually becoming more popular on the larger sizes.

**Selector Switch Control.** Here a three position switch is usually mounted in the cover. In one position the starter is controlled by some remote, automatic pilot device, either 2-wire or 3-wire. The center position is off and the third position on, irrespective of the setting of the pilot device. This is ideal for emergency hand operation, or prelim-

inary control during a set-up or adjustment period of a machine, which will subsequently run on automatic control.

**3-Wire Thermostat Control.** This is found mainly on small contactors. While it is not listed with most starters, it can be supplied, and can also be supplied in combination with selector switch control for use on oil burners or air conditioning equipment. It is for use with thermostats of the slow make type; the closing of one contact causing the starter to close and the closing of another contact causing the starter to open.

**Automatic Resetting.** This refers to the overload relay. After the relay trips on an overload and the starter opens, the relay design may be such that it must be reset by hand, or it may reset automatically. If the relay resets itself immediately it is only suitable for use with a 3-wire control circuit; if it resets after a short delay it is suitable for recycling and may be used also with 2-wire control. One type of relay gives the option of hand reset or automatic recycling. Hand reset is used with 2-wire control when it is desirable to have the motor remain off until the operator can determine the cause of the overload and remove it, while automatic resetting is used with 2-wire (or 3-wire thermostat) control in applications where it is desirable to keep unattended machinery running just as much as possible in spite of possible overloads.

#### Overload Protection

In most cases a motor starter provides some kind of protection to the motor to prevent overheating and burnout in the event of a sustained overload. This is not always true, as the protection may be dispensed with entirely, or it may be furnished by some additional device, or it may be built into the motor itself. The requirements of the National Electrical Code vary with the size of the motor and the conditions of its use, but in general it may be said that the overload protection is required on all but the very small motors; here the value of the motor might not justify the cost of the protection, while in the event of motor burnout the branch circuit protective device is expected to open the circuit before a fire hazard is created.

When the motor starting device does not include overload protection it is customary to refer to it as a "switch" if it is manually operated, or as a "contactor" if magnetically operated; thus the word "starter" is reserved for use where overload protection is provided.

#### Ratings and Operating Temperatures

Motors are ordinarily designed and rated to operate at an ambient temperature of 40°C and to develop their rated

horsepower continuously with a maximum temperature rise which will depend on the type of motor. Especially in the larger sizes, standard motors are generally 40° motors, thus they are designed to have a temperature rise of 40°C above the ambient temperature. Other motors may rise as much as 50° or 55°—the rise is indicated on the motor nameplate.

Most motors are physically capable of delivering much more than their rated horsepower, but as the saturation of the magnetic structure generally commences to become noticeable at about rated horsepower further increase in the output requires an excessive increase in current with a corresponding increase in heating. The nature of electrically operated machinery is such that in many cases the overheating of the motor, if noticed, would be the first indication of the overload. It is for this reason that motors must be protected against overloads which would otherwise cause damaging heating.

It is apparent that a motor will reach a dangerous temperature more quickly with a heavy overload than it will with a light overload. Therefore most protective devices are of the "inverse time" type—that is, the heavier the overload the more quickly the motor will be disconnected from the line. The setting of the protective device, whether by adjusting screw of interchangeable heaters, will depend on the type of motor. The 40° motor operates with a greater safety factor than does the 50° or 55° motor; therefore the latter must be protected more closely than the 40° motor. Totally enclosed motors (splashproof, etc), should also be protected more closely. The usual difference between standard squirrel cage motors and totally enclosed or 50° motors is about 10 percent in the current setting of the protective device.

Because motors are rated to operate in an ambient temperature of 40°C motor controllers with their protective devices are also rated to operate in a temperature of 40°C. If the motor and its controller are subject to the same ambient any change in this temperature



**Type A magnetic starter sheet steel cabinet.**

*Electrical Contracting, April 1946*



will affect both. Thus a reduction in temperature will cause an increase in the current required to trip the protective device. However, the motor will stand a greater overload at the lower ambient. Generally these two are not exactly compensating, but are sufficiently so that no allowance need be made for the ambient so long as it falls within the usual operating range of 20° to 40°C.

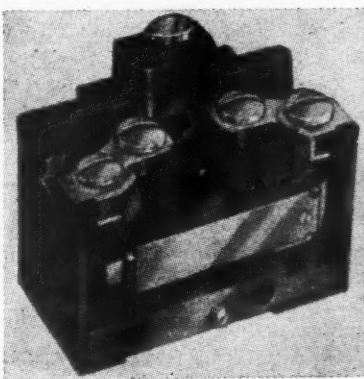
If the starter and the motor are located at different places so that there is likely to be regularly a temperature difference of 5°C (9°F) or more between them, some compensation should be made for this temperature difference when selecting the overload relay heaters. Since the compensation required will depend on the design and operating parameters of the relays, no set factor can be given. When needed, the manufacturer will supply this information for a particular starter. It is sometimes given as the number of degrees of difference to justify the use of heaters one size larger (or smaller), but it is most accurately applied as a change in the recommended factor for overcurrent protection. Thus a recommended factor of 1.25 might be reduced to 1.19 by the starter operating in a cooler location than the motor. Since the nearest heater rating is selected it is obvious that in some cases there would be a difference in the heater rating while in other cases there would not be any difference. In the example just mentioned there would be a change if the nearest heater rating had been slightly more than 125 percent; no change if the nearest rating had been—say 122 percent. Where the temperature difference between motor and starter exceeds 20°C or where either falls outside the range of 20°-40°C it is generally necessary to consult the manufacturer for a more accurate selection of the relay heaters.

#### Types of Overload Protection

Many years ago the only overload protection was by means of fuses. To keep them from blowing on the starting current a double pole knife switch was used, which did not place the fuses in the circuit until after the motor was started. Thus there was no protection during the starting period. Modern protection is by means of the magnetic relay or the thermal relay. To prevent the instant tripping of the magnetic relay during the starting period, or on a short harmless overload, it is necessary to introduce some form of time delay, which is generally in the form of an air or oil dashpot. Generally such devices are a little too fast to take full advantage of the overload capacity of the motor and by far the greater majority of all overload protective devices are of the thermal type which are so designed that the stor-

age of heat approximates that of the motor itself.

Thermal devices fall into two general classes. In one of these the heating coil acts on a bimetal strip, which as it heats deflects and at a certain adjusted point trips, and either by electrical or mechanical means brings about the opening of the motor starter. The other type is known as the solder pot and consists of a spindle around which the heating coil is placed. On the opposite end a ratchet is secured by a eutectic solder, which is a solder that melts "all at once", at a certain temperature. When the solder melts the ratchet is free to turn and the pawl which is normally restrained by the ratchet moves to a position which opens the circuit by electrical or mechanical means.



**Relay with cover and heater removed showing bimetal strip. Plunger set for "automatic" reset.**

With either type of relay the starter cannot be turned on again until the relay has cooled sufficiently for the bimetal to latch or the solder to harden. During this period the motor is also cooling, and the relay must cool slowly enough to prevent restarting the motor too soon. Obviously, a fast tripping relay can be faster resetting than a slow tripping relay. During the cooling period the source of the overload should be determined, and the fault corrected. In most cases this takes much longer than the cooling period, and the slow relay is advantageous.

The actual length of time required for cooling depends on the magnitude of the overload that caused the relay to trip. A relay that has tripped after an hour or two on a very slight overload will reset quickly, because the heat flow from heater to thermal element is very nearly balanced and cooling starts almost instantly. In extreme cases, the resetting time may be only a matter of a few seconds. On the other hand a relay which has tripped in a matter of seconds on locked rotor may require several minutes to reset. In this case, due to the thermal lag, the heater itself has become very nearly red hot at the instant of tripping; hence it continues to radiate

heat to the thermal element so that the temperature of the latter continues to rise for a little while before it begins to cool.

From the standpoint of the manufacturer the solder pot relay should be a little cheaper to manufacture since it does not require individual calibration, but to the user there is no essential difference. It is possible to make fast or slow operating relays of either the bimetal or solder pot type.

The solder pot relay is a little less affected by vibration, and its calibration may be a little more accurate than the bimetal type. However heaters are never made in increments closer than ten or twelve percent, so there is little object in extreme accuracy of calibration. In favor of the bimetal type of relay is its longer life under repeated operation, for there is no solder to oxidize or work out. Also, with the solder pot relay there is the possibility of attempting to reset it just at the instant of solidification, resulting in solidification in two sections not stuck together. This is a rare accident, but if it should happen it can generally be corrected by heating the spindle until the solder melts together. If uncertain of the amount of heat required for this, it can be done electrically: lock the rotor of the motor; short out the control circuit through the defective relay, leaving the good relay in the circuit; close the starter—the good relay will trip the starter and the other relay will receive just enough heat to remelt the solder.

Sometimes a relay trips after an overload has ceased. A typical illustration is found in the starting of a high inertia load, with the tripping occurring after the motor has come up to speed. This is not due to a defective relay, nor to the type of relay. It is due to the inherent thermal lag between the heater and bimetal or spindle and indicates that the overload existed for all but an instant of the time required to trip, with enough heat stored in the heater to cause tripping just after the overload ceased. If it happens repeatedly the cure is to reduce the load, or, if this appears safe, it is possible that the heater has been selected a little light and can be increased in size; but a fast operating relay may need to be replaced by a slower type. If even a slow relay is unsatisfactory there are available special time delay relays which can be set to take care of the particular load conditions encountered, but they are more expensive and should be installed only on the advice of a qualified control engineer.

If the reset button on the starter is held or wedged down it will not prevent the relay from tripping on an overload; it will simply produce the equivalent of automatic resetting. Thus the relay is

said to be trip free of the reset button, and it is a desirable feature on any starter. The better types of manual starters are also trip-free, for while the handle normally moves to the off position when the starter trips on an overload, the tripping is not dependent on this motion and the handle may be held in the on position without effect.

There are a few highly specialized applications where it may on occasion, be desirable to keep the motor running at all costs, notwithstanding the overload. This is best accomplished by the use of a magnetic starter and a switch through the overload relays. The main application is on battleships; hence such a switch is commonly called a "battle switch".

#### Selecting the Correct Heaters

The purpose of the overload relays is to protect the motor. To do this, they must be properly set. In the case of thermal relays with interchangeable heaters there is generally only one satisfactory heater—one that will protect the motor and still not trip off unnecessarily on short or harmless overloads, or continuous operation of the motor. Sometimes there will be two heaters either of which will do, one a little above the optimum calculated value and the other a little below it. The choice rarely extends to more than two except with standard motors used intermittently or on light loads.

Since most heaters are made in increments of 10 percent to 12 percent an intelligent selection will be impossible unless the rated full load motor current is known to within these limits; that is, expressing it on the plus or minus basis, to an accuracy better than 15 percent. As full load motor currents vary widely from published "average" tables, especially for motors below 1 hp., and for all multi-speed motors, it is a *sine quo non* of satisfactory protection that the heaters be selected on the basis of the motor nameplate current. If ordered from data obtained elsewhere they should be checked with the motor nameplate when installing. Even tables which are broken down according to speeds are generally unsatisfactory, and are entirely worthless in the case of multi-speed motors.

Sometimes the measured "full load" current of the motor does not agree with the nameplate rating. This is generally due to the fact that the exact horsepower output of the motor is unknown unless it is being measured simultaneously by a Prony brake or a dynamometer. Even if the motor is actually operated at exactly full load a slight difference may be found between the nameplate and measured currents. It should be disregarded and overload protection based on the nameplate rating. If the difference is

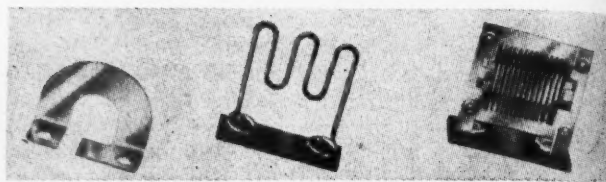
great it should be called to the attention of the motor manufacturer as indicating a possible error in marking or a fault in the motor.

This will occur very rarely and most so-called differences are found to be due to the fact that the motor is not operating at exactly rated output.

Relays are calibrated, and heaters, rated, so that in an ambient of 40°C. tripping will ultimately occur at the heater rating. All manufacturing variations must be such as to cause tripping at a lower rather than a higher value of current. The accuracy is generally about half of the increment between heaters. To obtain this accuracy when the same relays are used on different devices or in different enclosures it is convenient to give the heaters a code number and then print on a sticker attached to the device or enclosure, the ratings in amperes applicable to the various code numbers. This isn't quite as convenient as having the ampere-rating on the heater, but is the only practical method when solder-pot relays are used in a variety of applications. Bi-metal relays on the other hand can be calibrated according to their intended use, and if this is done do not require changes in the heater ratings.

In the actual selection of heaters the instructions of the control manufacturer should be followed implicitly. For most general purpose 40° motors, starter and motor both operating at normal room temperature (about 70 to 100°F) a heater approximately 25 percent greater than full load motor current should be selected.

And how about overloading the motor? In August 1942, the suggestion was made that motors be somewhat overloaded to help save critical materials. For example, a standard motor rated for a 40° ambient and having a 40° rise is frequently used in lower ambients and under more favorable conditions than continuous operation at rated load. This motor might then be applied to loads up to 125 percent of its rating which would otherwise call for the next larger size motor. In this case the selection of heaters is difficult. The increase in motor current is unpredictable, and the "safety factor" for the motor is unknown. However, since the increase in rating is partially justified by the operation at the lower ambient, and since this ambient also increases the current required to trip the relay, no change in heater rating is to be made for this portion of the increased motor rating. This also applies to the portion of the increased motor rating which is



Heater coils for overload relays are made in a variety of designs, according to their current ratings.

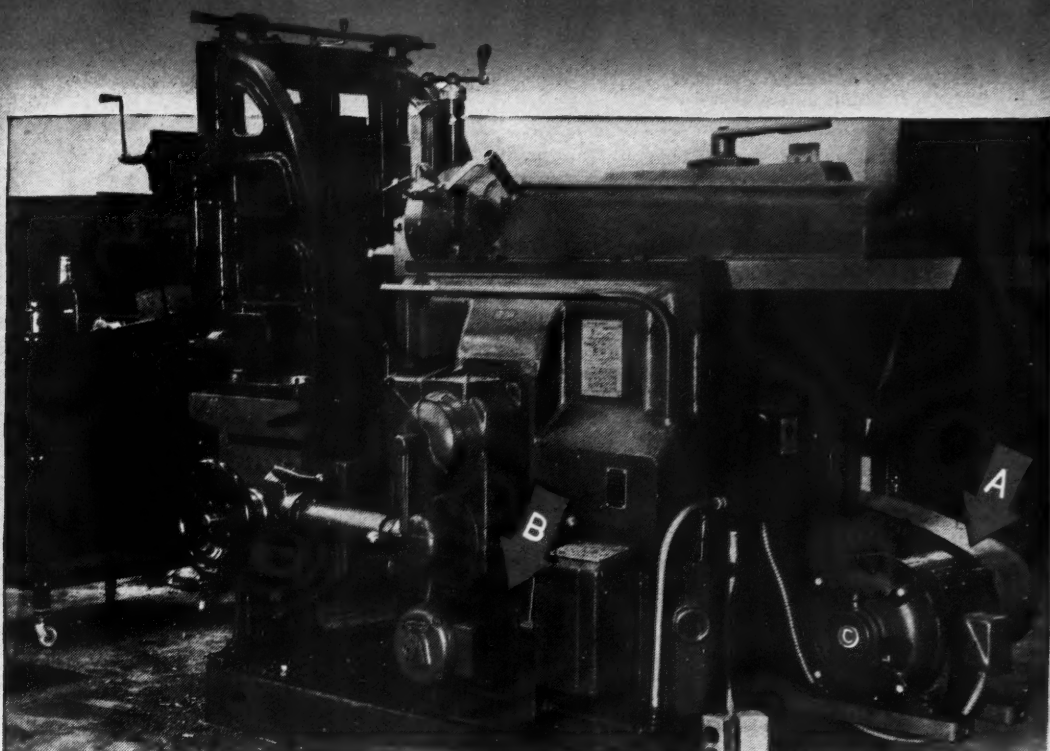
justified by anticipated intermittent or light load operation. Perhaps a small portion of the increased rating represents just downright overloading of the motor. Before increasing the heater size to take care of this, it should be remembered that the standard method of heater selection already provides for some overloading. It will probably be unsafe to increase the heater by more than one size. Probably the best way, lacking more scientific information, is to increase by 5 percent or 6 percent the factor used in determining the heaters. Thus the heater nearest 130 percent of full load motor current would be selected, rather than the one nearest 125 percent. In some cases this would result in a larger heater; in other cases it would not.

It should be remembered that attempting to operate a motor near the upper limit of its factor of safety will require some care and thought, and even with the most carefully selected overload protection there is somewhat more risk than when operating at rated load. With conservation during the war as the objective, overrating, even with the loss of an occasional motor, was thought justifiable so long as it did not create a fire or other hazard to the plant. The emergency over, a more conservative policy is now recommended.



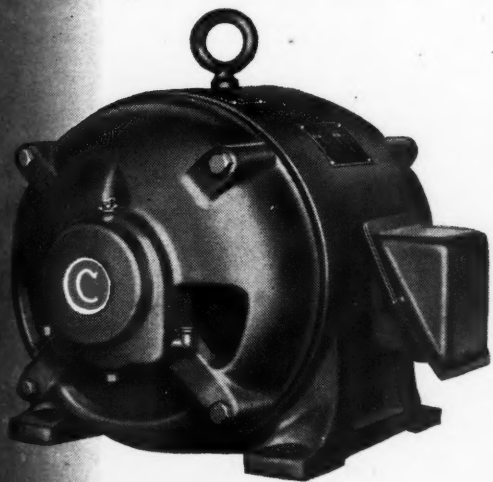
Trio active in Chicago's electrical industry activities includes (L to R) Larry Mangione, Electric Supply Corp.; J. R. Strom, vice-president, United Electrical Construction Co.; and F. I. Richards, General Elec. Co.





(A) 3 horsepower Squirrel Cage main drive Motor for shaper. Top half of motor enclosed. (B)  $\frac{1}{2}$  horsepower Squirrel Cage traversing Motor drives the table gears moving the work across the tool travel.

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# DATA SHEET

The number at the right is a classification for convenience in filing and for a future data sheet index

C-6

## D-C Control Circuits—I

Trouble shooting on d-c controls can be made easy if one has a clear understanding of the basic principles and circuits involved. The following data sheets are designed to provide this information.

Direct current motors of less than 1-hp. rating, in general, can be started across the line. For larger motors, however, it is usually necessary to put resistance in series with the armature when it is connected to the line. This resistance reduces the initial starting current to a point where successful commutation of the motor is possible. As the motor comes up to speed and the

counter-voltage generated is sufficient to limit the current peaks to a suitable value, this resistance is shorted out in steps. Accelerating contactors that short out successive steps of starting resistance may be controlled by counter-voltage or by definite-time relays.

For small motors used on auxiliary devices the counter-e.m.f. starter is satisfactory. However, the definite-time starter, which has the advantage of being independent of load conditions, is more widely used.

Some of the circuits commonly used for d-c motor control are illustrated below.

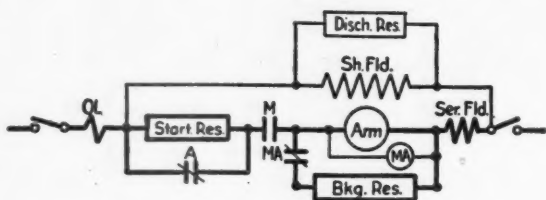


FIG. 1—Basic requirements of a non-reversing d.c. starter in its simplest form.

When the start pushbutton is depressed line contactor *M* closes, energizing the motor armature through the starting resistance. As the motor comes up to speed the countervoltage, or the voltage across motor armature and series field, increases. At a predetermined value the accelerating contactor *A* closes, shorting out the starting resistance.

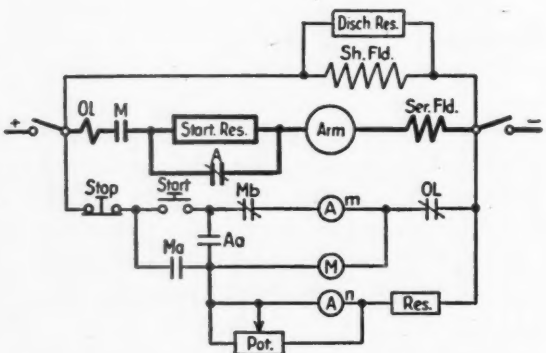


FIG. 2—Typical, non-reversing constant-speed, definite-time starter. The accelerating contactor is equipped with a time-delay mechanism. This contactor, *A*, is of the magnetic-flux-delay type. It is spring-closed, equipped with two coils, and has a magnetic circuit that retains enough magnetism to hold the contactor armature closed and the contact open indefinitely. Main coil *Am* has sufficient pull to pick up the armature and produce permanent magnetization. Neutralizing coil *An* is connected for polarity opposite to the main coil. It is not strong enough to affect the pick-up or holding ability of the main coil but, when the latter is deenergized, the neutralizing coil will buck the residual magnetism so that the contactor armature is released by the spring and the contacts close. By adjusting the potentiometer the voltage impressed on this coil and hence the time required for the contactor to drop out can be varied. When the start button is depressed accelerating contactor coil *Am* is energized, causing contact *A* to open and auxiliary contact *Aa* to close. Contact *Aa* energizes line contactor *M*, and normally open auxiliary contacts *Ma* establish a holding circuit. Neutralizing coil *An* is also energized. Opening of contact *Mb* deenergizes coil *Am* and contactor *A* starts timing. At the set time the main normally closed contacts on *A* close, shorting out the starting resistance and putting the motor across the line.

Data from Westinghouse Electric & Mfg. Co.

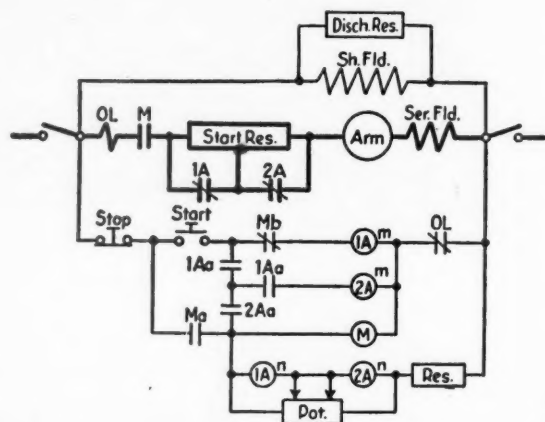


FIG. 3—The same kind of a starter as in Figure 2 but designed for use with a motor of larger horsepower.

This starter provides two steps of definite-time starting. The operation is essentially the same as in Figure 2 but the first accelerating contactor, *1A*, does not short out all the starting resistance. It also starts *2A* timing, which finally shorts out the remaining resistance. The normally open auxiliary contacts on the accelerating contactors in Figures 2 and 3 are arranged so that it is necessary for the accelerators to pick up before the line contactor can be energized. This is a safety interlocking scheme that prevents starting the motor across the line, if the accelerating contactors are not functioning properly.

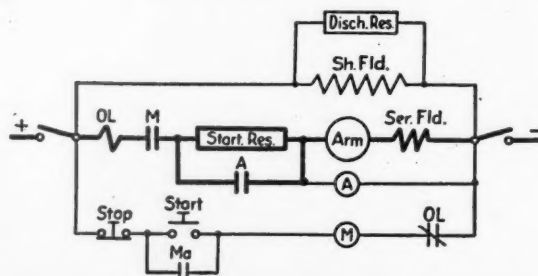


FIG. 4—One way of producing dynamic braking.

Control circuits have been omitted, since they are a duplicate of those shown in Figures 2 and 3. Line contactor *M* has two poles, one normally open and the other normally closed. Both poles are equipped with an operating coil and are on the same armature, which is hinged between the contacts. In starting, when line contactor *M* closes normally closed contact *MA* opens. When the stop button is depressed the line contactor drops out and contacts *MA* close. As the motor accelerates, voltage is impressed on coil *Ma* but it cannot close contact *Ma* until the open coil *M* is closed. When the stop button is depressed the line contactor opens and contacts *Ma* are closed both by gravity and the coil *Ma*. The motor, now acting as a generator, is connected to the braking resistor and coil *MA* is energized by the resultant voltage. It causes *MA* to seal in tightly, establishing good contact pressure and preventing this contact from bouncing open.

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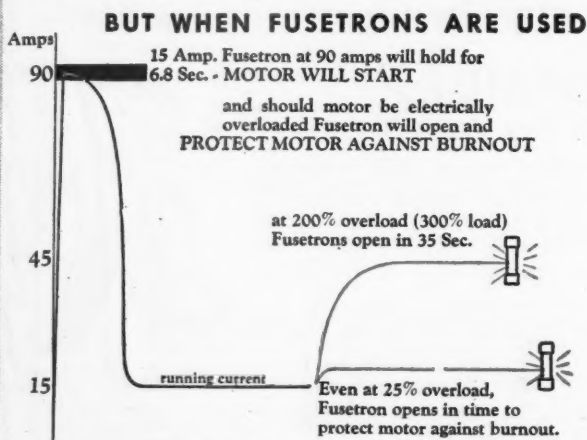
When so used, Fusetrons protect motors from ANY harmful excess of current—caused by such things as being stalled, lack of oil, worn bearings, tight belt, overloading, wrong voltage or SINGLE PHASING.

### Ordinary Circuit Protective Devices Cannot Protect Motors Against Burnout

Such devices do not have sufficient time-lag, when used in motor-running protection size, to hold the motor-starting current. For example:

The starting current of a 15 amp. A. C. motor is 90 amps. or more, enough to blow an ordinary 15 amp. fuse in about 1/10 second, or a 15 amp. ordinary breaker in about 2 1/2 seconds. In either case, the circuit would be shut down before the motor could get up to speed.

To permit a motor to start a 35 amp. breaker or a 45-amp. fuse would commonly be used. Then an excess current of from 133% to 200% of the motor rating could cause the motor to burn out—without opening the protective device.



Thus any motor from 1/10 to 500 amp. size can, on normal installations, be protected by Fusetrons if used in motor-running protection size.

**Fusetrons Give DOUBLE Protection to Large Motors.** Of course, larger motors are protected with thermal cutouts or overload relays. They save many motors—but experience shows that such

devices sometimes fail to operate and a motor burns out.

By replacing fuses used for short-circuit protection with Fusetrons of MOTOR-RUNNING protection size, you get the same short-circuit protection PLUS DOUBLE PROTECTION against motor burnout from single phasing or any other cause.

**Fusetrons will act INDEPENDENTLY to SAVE THE MOTOR.** There is nothing to stick, nothing to go wrong. They cannot be reset nor can corrosion or dirt lengthen their blowing time. When the solder in the thermal cutout melts the circuit is open—there is no way it can be held in or jammed.

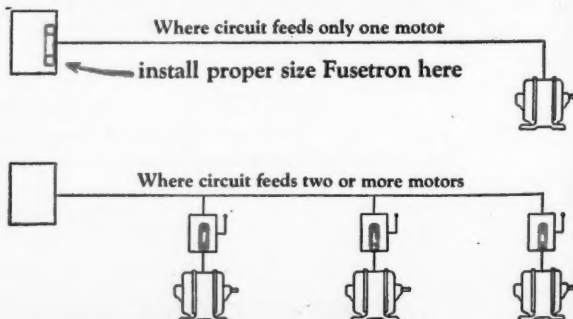
**Fusetrons provide simplest way to prevent damage from Single Phasing.** When single phasing occurs the current flowing through motor and through Fusetrons in the remaining phase increased about 100%. (Theoretically 73% but change in efficiency and power factor makes it about 100%).

This 100% overload on Fusetrons of MOTOR-RUNNING protection size opens them and STOPS FLOW OF CURRENT to the motor.

Never before has such dependable single phasing protection been available to prevent motor burnouts.

**Fusetrons make protection of SMALL Motors against burnout, simple and inexpensive.** Heretofore, SMALL motors have often been left unprotected because the cost of protection has been too great compared to the cost of replacing the motor. Yet a burnout means replacing the motor—PLUS the loss of labor and production.

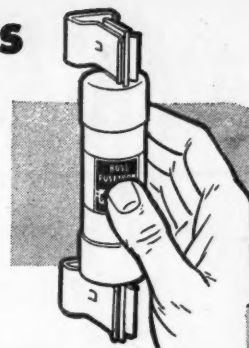
Now look how simple it is to avoid such losses...



Install Fusetron in switch or fuse block to protect each individual motor... or on portable tools or devices, install Fusetron in attachment plug or connector or in a fuse block attached to device.

# A Fusetron turns any set of fuse clips into a Motor Protective Device . . .

...as accurate, as safe and as dependable as any device on the market; regardless of cost. Fusetrons have the same degree of approval for both motor-running protection, under National Electrical Code and Underwriters' Laboratories Standards, as do the most expensive devices made.



## WHAT IS THE FUSETRON?

The Fusetron is a DUAL element device—A Fuse to which is added a Thermal Cutout.

The result is a fuse with tremendous time-lag and much less electrical resistance.

Fusetrons have the same degree of Underwriters' Laboratories' approval for both motor-running and circuit-protection as the most expensive devices made.

*Fit standard fuse blocks*

Fusetrons are made to same dimensions as ordinary fuses and fit all standard fuse holders.

They are obtainable in all sizes from 1/10 to 600 ampere—in both 250 and 600 volt types.

Also obtainable in plug type and Tamper-resisting type (Fustats) for 125 volt circuits.

**Their Cost is Surprisingly Low**

## Says a Nationally Known Consulting Engineer

"We recommend Fusetrons to all our clients because we have found them superior to any other device to protect motors against burnout.

"Here's an illustration of our experience with Fusetrons.

"One of our filling station clients reported by telephone that his compressor was not operating. Our Mr. Hrastich called and found that Fusetrons in the circuit had blown. With new Fusetrons installed, the compressor operated for 3 minutes, then slowed down and the Fusetrons blew. Inspection showed that the bearings of the motor were dry. When the bearings were oiled, the motor operated without any difficulty.

"The client could see for himself that the Fusetrons had saved him a burned-out motor, a major shutdown and a repair bill."

H. J. Brandenburg  
Carleton B. Fox Company,  
St. Louis, Missouri.

**INSTALLED THROUGHOUT THE ENTIRE ELECTRICAL SYSTEM, FUSETRONS  
GIVE MANY KINDS OF PROTECTION HERETOFORE NOT AVAILABLE**

*Fusetrons do everything fuses do. They open on harmful overloads and on short-circuits stop the flow of current quickly and safely, all of which is confirmed by the Underwriters' Laboratories Label . . . and in addition you can*

★ **Entirely wipe out needless blows caused by motor starting currents or other harmless overloads.**

Fusetrons have tremendous time-lag. They hold 500% load more than 10 seconds whereas most sizes of ordinary fuses blow in less than one second. They won't open on starting currents or harmless overloads (heavy overloads for a short time or light overloads for a longer time). Fusetrons won't shut down a circuit needlessly. They open only when something goes wrong.

★ **Give Thermal Protection to Panelboards and Switches**

The thermal cutout in the Fusetron will open whenever its temperature reaches 280° F. Thus if poor contact heat develops from any cause the Fusetron cuts off the current before damaging temperatures can be reached.

Ordinary fuses can't so protect because the temperature of the link must reach 786° F. before it will melt out.

With Fusetrons you are warned that a minor maintenance job is needed instead of having panel or switch damaged or destroyed by poor contact.

★ **Prevent Needless Blows caused by Heating in Panels and Switches**

Fuses have 55 to 140% greater electrical resistance at full load than Fusetrons, hence Fusetrons produce less heat than any fuses. They operate cooler and elimi-

nate useless shutdown troubles caused by fuses running too hot.

★ **Permit use of larger motor or adding more motors on circuit WITHOUT installing larger switch or panel**

The operating load on Fusetrons can be close to their ampere rating because Fusetrons hold starting currents. But ordinary fuses must be installed oversize because they lack sufficient time-lag to hold starting currents.

By replacing oversize fuses with Fusetrons, you can load panels or switches near their capacity. A larger motor or additional motors can be installed without the trouble or expense of changing the panel or switch.

★ **On new installations, PROPER size switches and panels can be used instead of OVERSIZE**

With ordinary fuses, switches and panels must be oversize because fuses larger than the operating load must be used to hold starting currents.

But Fusetrons hold starting currents, therefore, PROPER size switches and panels to fit the load can be installed, saving money and space.

★ **Protect motors against burnout (See opposite page)**

★ **Protect Coils, Transformers and Solenoids against burnout**

Install a proper size Fusetron. It won't open on harmless overloads of normal current surges, yet should a dangerous overload occur for any reason it will cut off the current to prevent a burnout.

**BEFORE YOU MAKE ANY CHANGES OR START ANY NEW WORK**

**GET ALL THE FACTS—CHECK THE COSTS  
USE THE COUPON**

Even one lost motor or one needless shutdown or one destroyed panel, may cost you more than replacing every fuse with a Fusetron. Don't risk such losses, change over the whole plant to Fusetrons at once.

# BUSS FUSETRONS

BUSSMANN MFG. CO., University at Jefferson,  
St. Louis 7, Mo. (Division McGraw Electric Co.)  
Please send me complete facts about BUSS Fusetrons.

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# DATA SHEET

The number at the right is a classification for convenience in filing and for a future data sheet index

C-7

## D-C Control Circuits—II

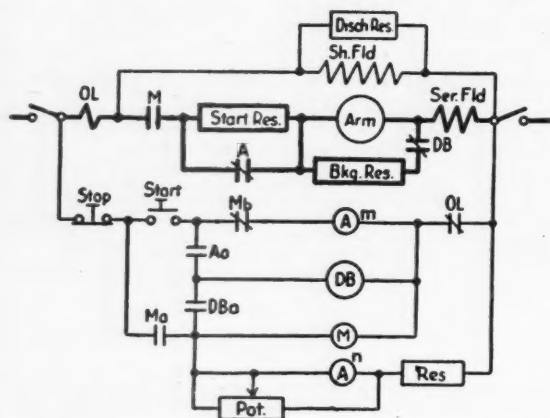


FIG. 5—In the more modern types of controllers a separate spring-closed contactor is used for dynamic braking.

Operation is similar to that described for Figure 2, except that the energizing of coil *A<sub>m</sub>* and the picking up of accelerating contactor *A*, closing contact *A<sub>a</sub>*, energizes dynamic braking contactor *DB*, which in turn energizes line contactor *M* through its auxiliary contact, *DB<sub>a</sub>*. This arrangement not only insures that the dynamic braking contactor is open but also that it is open before the line contactor can close. In order to obtain accurate inching, such as is required for most machine tool drives, the motor must respond instantly to the operation of the pushbutton. In the scheme shown in Figure 5 the closing of the line contactor is delayed until accelerating contactor and the dynamic braking contactor pick up.

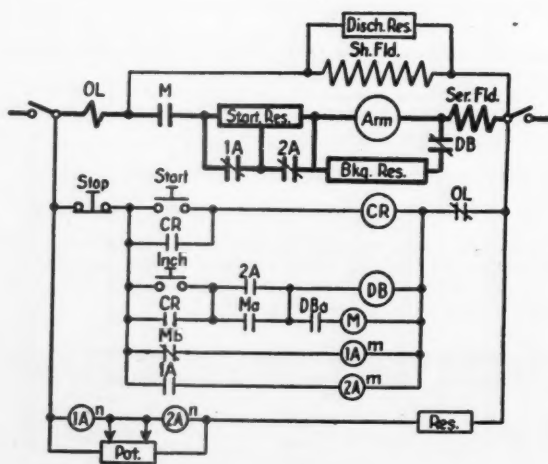


FIG. 6—Arrangement to secure quicker response of motor, for more accurate inching.

Accelerating contactors 1A and 2A are energized in the off position. Hence, when the start button is depressed, the dynamic braking contactor picks up immediately and its auxiliary contact *DB<sub>a</sub>* picks up *M* line contactor.

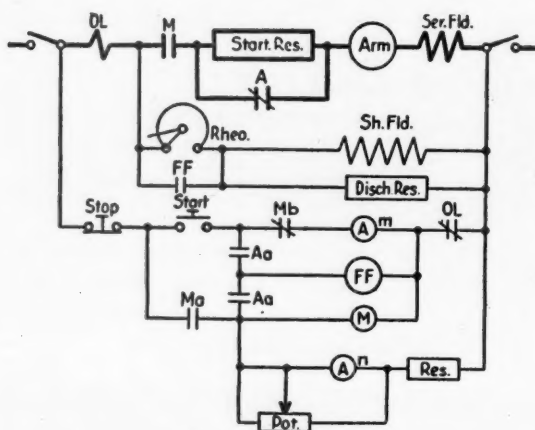


FIG. 7—One method of connecting full field relay, used with adjustable-speed motors having a speed range in excess of 2 to 1. Coil *FF* is energized by the closing of the normally open auxiliary contact *A<sub>a</sub>* and remains closed until the last accelerating contactor drops out. Contacts of the full field relay, *FF*, are connected to short out the field rheostat thereby applying maximum field strength to the motor during the starting period.

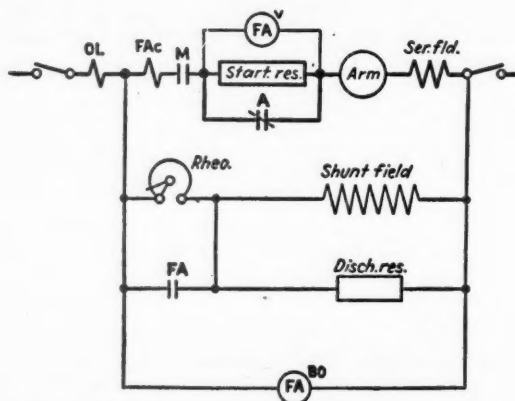
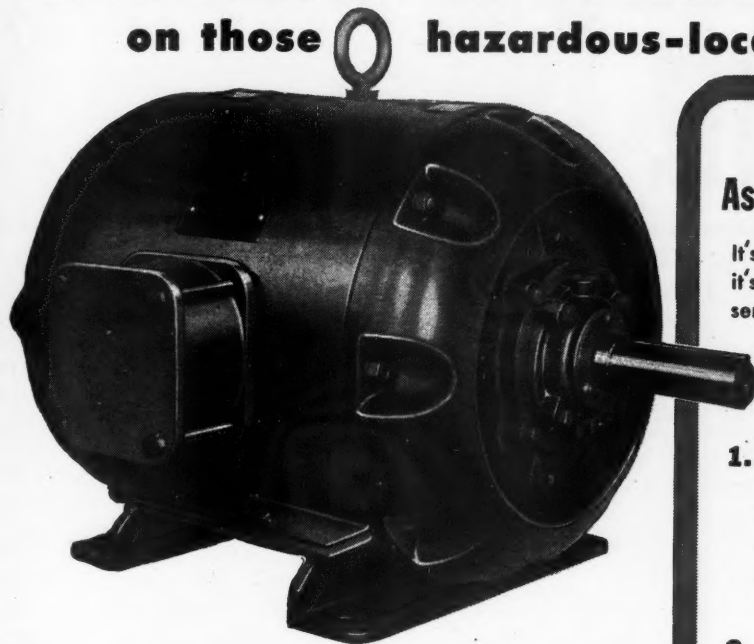


FIG. 8—Another method of applying the full-field relay.

This arrangement insures full field on starting, and provides for limiting the armature current when the motor is accelerating from the full-field speed to the speed set by the rheostat. Field accelerating relay *FA* is equipped with two coils, one a voltage coil connected across the starting resistance, the other a current coil connected in series with the motor armature. See Figure 2 for the remainder of the circuit. When line contactor *M* closes, the voltage drop across the starting resistor is practically line voltage, and relay *FA* is picked up quickly. When accelerating contactor *A* closes, voltage coil *FA<sub>v</sub>* is shorted, but closing of *A* produces a second current peak, and current coil *FA<sub>c</sub>* holds relay *FA* closed. As motor approaches full-field speed this current delays and allows the *FA* contacts to open, weakening the motor field. When the motor attempts to accelerate the line, current again increases. If it exceeds the pick-up value of coil *FA<sub>c</sub>* the relay will close its contacts, arresting acceleration and causing a delay of line current, which again causes *FA* to drop out. High inductance of the motor field, plus inertia of the motor and drive prevent rapid changes in speed. Hence the motor will not reduce its speed, but the increased field current will reduce the armature current and cause *FA* to drop out. The fluttering action will continue until the motor reaches the speed set by the rheostat. Setting of the *FA* relay current coil determines the maximum current draw during this part of the accelerating period. Since relay *FA* must handle the highly inductive field circuit, a good blowout arrangement is necessary. Hence the relay is usually equipped with a shunt blowout coil, *FA<sub>bo</sub>*.

Data from Westinghouse Electric & Mfg. Co.

# Save Money Three Ways with Wagner EXPLOSION-PROOF MOTORS on those hazardous-location motor drives



**YOU** save three ways when you install Wagner type HP Explosion-Proof Motors in hazardous locations:

- 1. You save on engineering and construction costs** because Wagner type HP motors can operate in explosive atmospheres with perfect safety, so there's no need for special vaults to house the motors, and you avoid troublesome remote-drive arrangements for delivering power from outside the hazardous area.
- 2. You save on maintenance costs** because Wagner explosion-proof motors are totally-enclosed fan-cooled—the vital parts of the motor are sealed against the entrance of dust, fumes, and moisture which are the cause of most motor maintenance.
- 3. You save on insurance costs** because when you use Wagner explosion-proof motors on those hazardous-location drives your plant has the best in electrical safety. Wagner type HP motors have been approved by the Underwriters' Laboratories for Class I Group D hazardous locations where gasoline, petroleum, naphtha, alcohols, acetone, lacquer solvent vapors, or natural gas are manufactured, used, or handled.

Wagner type HP Explosion-Proof motors are varied electrically to meet a wide variety of application requirements. For a complete description of the type HP, as well as all other types of Wagner motors, ask for Bulletin MU-185, and address your request to Wagner Electric Corporation, 6413 Plymouth Avenue, St. Louis 14, Mo.

## These Construction Features Assure Dependability and Long Life

It's one thing for a motor to be explosion-proof; it's another thing for a motor to give dependable service over many years.

Wagner type HP explosion-proof motors are dependable and long lived — and here are a few of the many reasons why:

### 1. CAST ALUMINUM ROTORS

One-piece construction of aluminum which does not crystalize or become brittle when subjected to heating during overload—thus the cause of many rotor burnouts is eliminated in Wagner type HP motors.

### 2. CARTRIDGE BEARINGS

Cartridge construction completely seals and protects the bearings even on removal of the rotor assembly. Bearings are of liberal size.

### 3. ALLOY-STEEL SHAFT

Shaft is of special alloy steel which increases factor of safety under abnormal load.

### 4. THOROUGHLY-INSULATED WINDINGS

The stator windings are thoroughly insulated with liberal quantities of the highest-quality materials.

### 5. STEEL FRAME

The stator frame and feet are fabricated of heavy steel—unbreakable even under severe strains. The frame and feet are welded into one integral unit—no parts to work loose and cause trouble.

M46-5

*Consult Wagner Engineers on all Electric Motor Problems*

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# Wagner

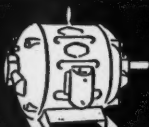
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NoRoL • Tachograph



General-Purpose  
Motors



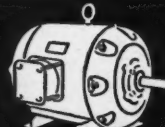
Wound-Rotor  
Motors



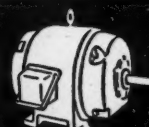
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LEASIDE, ONTARIO—Wagner motor parts are available at 350 Wagner-owned and -contract repair shops.



QUESTIONS from readers on problems of industrial equipment, installation, maintenance and repair. Answered by electrical maintenance engineers and industrial electrical contractors out of their experience. For every question and every answer published, we pay \$5.00.

# READER'S QUIZ

## TESTING ROTOR CLIPS

**Q**UESTION 211—*We have in service several 20 hp.-1800 rpm.-slip ring motors. The rotors are bar wound and are connected series star. Because of insufficient testing equipment, it has been necessary to depend on our eyes alone to find badly soldered rotor clips, or those about to go bad. Have any of the readers run into or built a tester to detect the above trouble?*—H.P.H.

**A.** TO QUESTION 211—An ideal instrument for this kind of testing is a direct-reading ohmmeter with a full scale reading of 1 ohm and various ranges making it possible to accurately read as low as 1 microhm. However, as this type of instrument costs several hundred dollars, H.P.H. will want more practical information.

If instruments for measuring potential drop are not available for these low resistance circuits, I can offer a practical method of loading the copper to the N.E.C. values and then feel for hot spots at the clip connections. If low voltage direct current is not available and it is possible to stall the rotor, it is very convenient to have the stator winding induce these heavy currents in the rotor and feel for the hot clips. This method has the hazard of higher voltage but with the experienced electrician should present no problem.—E.J.K.

**A.** TO QUESTION 211—I use a feed through transformer having 2000 turns on 1 side of a transformer core. I feed one ampere through enough turns of No. 12 wire through the transformer core, to give me a full scale reading on the 2 volt scale of my 2000 ohm per volt copper oxide voltmeter.

Then I place the 2 ends of the No. 12 wire on any place I want to measure extra low resistance. The sensitivity can be varied by using more No. 12 wire or a thinner size wire for lower sensitivity, or a heavier size wire for higher sensitivity.—H.S.

**A.** TO QUESTION 211—The rotor can be tested by first effectively short-circuiting the slip rings. A low a-c voltage is then impressed across one phase of the stator with a suitable ammeter or bank of lamps connected in circuit. The rotor is then turned slowly by hand. A poor bar contact when passed under a magnetic pole will cause the lamps to flicker or an ammeter needle to fluctuate.—T.B.B.

**A.** TO QUESTION 211—A test lamp may show up the badly soldered rotor clip. It will probably be necessary to lift the brushes from the slip rings, so that the external circuit will not shunt the rotor clip under test.—C.P.S.

## ELECTRIC WATER SYSTEMS

**Q**UESTION 212—*Our customers who have electric water systems on REA lines are experiencing a lot of trouble from lightning. What is the best method of protecting these from such damage? Can any effort be made to ground any portion of the wiring? If so, what type of ground should be used?*—C.J.R.

**A.** TO QUESTION 212—Some REA lines do not bring in enough revenue to afford the best protection. Here are some methods. Two ground wires size 00 or heavier may be used to take care of direct lightning hits in the span. A thin wire will give some protection against almost everything but a direct hit.

At transformers, you will need lightning arrestors at each ungrounded lead, high tension fuses, and a reclosing secondary circuit breaker. The main problem is to give the lightning a chance to use its energy before reaching vital electrical parts.—H.S.

**A.** TO QUESTION 212—Lightning is causing trouble in the houses that have electric water systems

because the water pipe is being used for the grounding electrode. This is bad practice in localities where the majority of the grounds are driven because the water pipe ground as a rule has far less resistance than the average driven ground. Electricity follows the path of the least resistance; therefore, when lightning strikes, it goes to ground through one of the water pipe systems. I recommend that driven grounds be used in lieu of the water pipe systems and a request be made to the Power Company to check their grounds at the poles where the transformers are located to ascertain if they are effective. This will eliminate future troubles of this nature.—C.R.H.

## CORRECTION OF STROBOSCOPIC EFFECT

**Q**UESTION 213—*How can I reduce the stroboscopic effect to a fluorescent lighting installation? Our service is supplied from one single phase 60 cycle transformer with a 230/115 volt secondary.*—T.B.

**A.** TO QUESTION 213—The stroboscopic effect in modern fluorescent lamps is quite negligible if white 3500° K two lamp ballast fluorescent lamps are used in the lighting installation. A-c light sources have some variation in light output due to the cyclical variation of the current alternating at 120 cycles per second. Since fluorescent lamps depend entirely on the phosphorescent quality of the lamp coating to emit their light and the various colored phosphors vary considerably in their characteristics, the stroboscopic effect is more pronounced in this type of bulb than in the incandescent filament type. Many times the whirling or extreme flicker in a fluorescent lamp is confused with the natural stroboscopic effect of fluorescent lamps. Actually these effects can occur because some of the emission material is temporarily in the arc stream, because the bulb has not been properly seasoned at the factory, or because the bulb is near the end of its

life. The stroboscopic effect which is so annoying causes the eye to see multiple images of a moving object. Multiple images also appear when the eye is required to move rapidly from one spot to another.

The absolute minimum of stroboscopic effect in fluorescent installations has been experienced where three lamps have been installed on a separate leg of a three phase circuit. This is of course best accomplished where 4-wire 120/208 volt systems are used.

The relative stroboscopic effect of various methods of operating a fluorescent lamp has been tabulated by various fluorescent manufacturers approximately as follows:

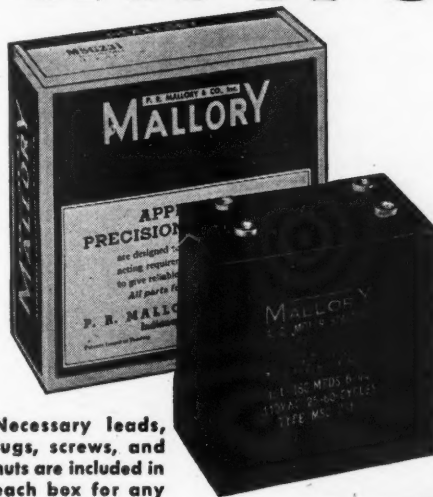
Type of lamp operation	Relative Stroboscopic Effect
1. 200 W. Mazda incandescent lamp .....	1
2. Daylight or white 3500° K three lamps on 4-wire 120/-208v. system .....	3
3. White 3500° K two lamp ballast .....	9
4. Daylight two lamp ballast..	10
5. White 3500° K Mazda fluorescent single lamp ....	19
6. Daylight Mazda fluorescent single lamp .....	21

We have a large fluorescent installation in our mill and offices and in no place have we been bothered with the stroboscopic effect of fluorescent lamps. We did have considerable trouble with single lamp daylight fluorescent desk fixtures in our drafting room. We have discontinued their use because of the very bad multiple image effect they produced. All our office fixtures are four lamp high power factor units with two lamp ballasts.—M.D.P.

**A.** TO QUESTION 213—To reduce the stroboscopic effect of a lighting installation on single phase service, you should use multiple lamp units of the power factor corrected type. This type fixture will have two or more lamps working off the same ballast. One lamp will operate at the normal low power factor, the other lamp will have a capacitor in series with it, so that the current through this lamp will be ahead of the current in the other lamp. Thus, the two lamps will overlap in light output but will not reach their peak at the same time. The result is that the installation will be much less subject to stroboscopic effects. If your installation is already in service, then you can correct the condition by installing new multiple lamp power factor corrected ballasts.—L.R.B.

**A.** TO QUESTION 213—When operating fluorescent equipment on single phase sources, the best means by far of obtaining stroboscopic correc-

# DEPEND ON—INSIST ON— P. R. MALLORY & CO., Inc. MALLORY CAPACITORS



Necessary leads, lugs, screws, and nuts are included in each box for any type connectors.

**Mallory MSG Capacitor:**—Small, compact AC Motor Starting Capacitor that fits almost every mounting bracket or box. Replaces rectangular capacitors with leads, lugs or studs. Each capacitor is packed with complete set of universal mounting hardware and installation instructions.



**Mallory Type "P" Capacitor:**—Plastic case overcomes moisture absorption problems, and provides maximum insulation. May be used to replace cardboard insulated aluminum-case capacitors. Splash-proof plastic end cap and simplified "snap on" mounting bracket available when capacitor is used as original equipment.

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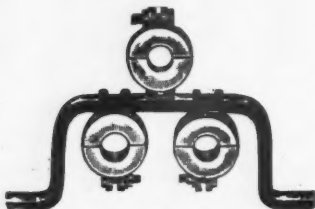
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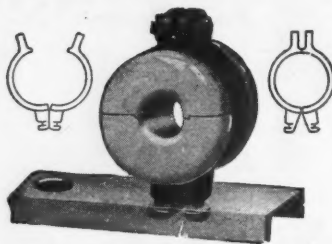


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tion is by means of the so-called two lamp ballast with power factor correction. This type of ballast accomplishes both power factor correction and stroboscopic correction by means of a capacitor to cause the current in the one lamp, and consequently its light output, to lead the current in the other lamp by almost 180°. This results in a reasonably steady light output from both of the tubes operating together.

Results are at their best if two light fixtures are used, but it is possible to use single lamp fixtures and run the wires from the ballast to the individual fixtures, keeping the out of phase lamps as close as possible to secure as steady illumination as possible at any one point in the area.

Such illumination is satisfactory in almost any instance where stroboscopic effect is important. If further correction is necessary, staggering adjacent lamps on the alternate phases of a three phase supply (if available) will give slightly better results because the peak light outputs of adjacent lamps are  $\frac{1}{2}$  of a cycle apart instead of  $\frac{1}{4}$  of a cycle apart.

It is also possible to obtain continuous light output from this type of source with d-c operation but with a great loss of efficiency and with the addition of some operating difficulties, inherent with d-c operation. Keep in mind that at least 200 volts is necessary to "fire" the ordinary 40 watt tube as it is impossible to use a transformer, as in a-c operation to raise the line voltage to the lamp operating and starting voltage.

When using the corrected two lamp ballasts, any great increase in stroboscopic effect means that the capacitor in that ballast is short circuited, causing both lamps to operate together. A low or no voltage reading from the red to the blue wires on the ballast (read on a high resistance voltmeter) would indicate such an "in phase" condition and indicates probable failure of the ballast as the auto-transformer generally will not continue to supply two lamp currents in phase for an extended period.—A.L.P.

**A.** TO QUESTION 213—Check circuit load and voltage. Also check lamps for length of life. Proper voltage and periodic change of lamps will keep down flicker.

Bring voltage up to required value. Replace old lamps where necessary.

Change location of lights with respect to moving wheels and belts. If necessary, increase or decrease speed of wheels and belts to get desired results.—L.J.G.

**A.** TO QUESTION 213—While T. B. does not state the type of units used in his fluorescent lighting installation, that is, the number of lamps, it may be assumed that they are not single lamp units. To reduce the strobo-

scopic effect it is necessary to use ballasts which provide a capacity in one lamp circuit of each unit, where two lamp units are used, and similarly, in two lamp circuits if four lamp units are used. The effect of the capacitor is to change the zero point in the current cycle of the lamp to which it is applied, thus shifting the "out" instant. The two lamps in the lighting unit then are not "out" at the same instant but at different instants. The effect is to have one lamp in operation at all times. The only stroboscopic effect remaining is a double frequency reduction in illumination and not a complete single frequency stoppage. This seldom proves objectionable. I understand these ballasts can be obtained from a number of manufacturers. To apply individual capacitors would require further information regarding the specific units involved.—W.B.M.

**A.** TO QUESTION 213—The most satisfactory method of minimizing annoyance due to normal flicker of fluorescent lamps when operated on alternating current circuits is the use of two lamp ballasts. A series capacitor in the leading branch of the two lamp circuit produces a power factor of about 50 percent leading, which means that the current wave reaches its maximum 60 deg. ahead of the voltage wave. The other lamp is ballasted by inductance alone and has a power factor of about 50 percent lagging, which means that the peak of its current wave will be reached 60 deg. after the peak of the voltage wave. Since the variations in light output closely follow those of lamp current, the maximum light output of the leading lamps will be about 120 deg. (1/80 sec. for 60 cycle circuits) ahead of the maximum light output of one lamp will overlap the minimum light output of the other lamp and the flicker will be very much reduced.—C.H.G.

### Can you ANSWER these QUESTIONS

**QUESTION N9**—In our machine shop we have a high center bay with two crane ways. The upper craneway has two slow speed heavy duty cranes and the lower craneway has four high speed light duty cranes. We have had several accidents due to a lower bay crane hitting the cables of the lowered hook on an upper bay crane when working in the same area on different jobs. We feel that the operators and riggers cannot be held totally responsible for these accidents without some kind of a warning device to indicate that two cranes on different craneways are approaching the same area. It is considered that the warning device should be in both cabs concerned

# BEARINGS



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**Johnson**

**EM**

### Catalogue

76 Pages, fully illustrated. Write for a copy TODAY.

**EM** means Electric Motor. In Bearings it means a product of Johnson Bronze. You can't buy better bearings at any price. Over 250 stock sizes to choose from . . . all completely machined ready for immediate installation. The next time you need Electric Motor Bearings . . . specify Johnson **EM**.

**JOHNSON**

SLEEVE BEARING

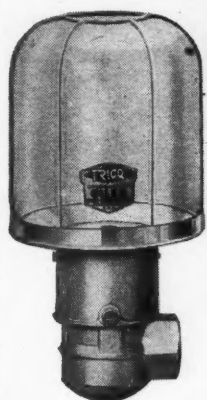
490 S. MILL STREET



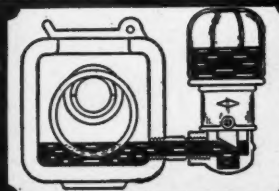
**BRONZE**

HEADQUARTERS

NEW CASTLE, PA.



JUST THE  
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OF OIL  
AUTOMATICALLY  
WITH



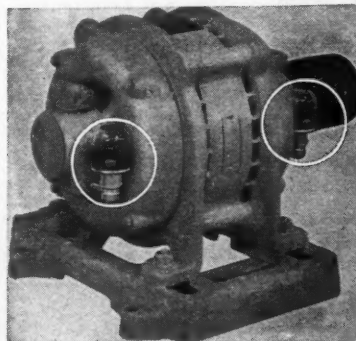
**TRICO** CONSTANT LEVEL **OILERS**

As long as there is oil in the plastic reservoir the bearing will receive the right amount of oil automatically. There's no guesswork—no human failures—no downtime for hand-oiling. Replaces the old-fashioned "trust-to-luck" hand-oiling method. One filling lasts a long time.

### Modernize with Trico Oilers for

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- Less messy and slippery floors or damage to materials
- Minimum fire hazards
- Up-to-date streamlined appearance
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**TRICO FUSE MFG. CO.** Milwaukee 12, Wis.  
In Canada—IRVING SMITH LIMITED—Montreal

This motor is modernized with TRICO "Opto-Matic" Constant-level Oilers. Visible oil supply—no guesswork.



# Electricity

**ONAN** ELECTRIC PLANTS

## FOR ANY JOB—ANYWHERE

ONAN ELECTRIC GENERATING PLANTS supply reliable, economical electric service for industrial uses, as well as for scores of other general applications.

Driven by Onan 4-cycle gasoline engines, these power units are of single-unit, compact design and sturdy construction. Suitable for mobile, stationary or emergency service.

Models range from 350 to 35,000 watts, A. C. types from 115 to 660 volts, 50, 60, 180 cycles, single or three-phase and 400, 500 and 800 cycles, single phase. D. C. types from 6 to 4000 volts. Also available in dual voltage and special frequency types.

Model shown is from W2C series: 2000 to 3500 watts; powered by Onan two-cylinder, water-cooled engine.

*Write For Folder 690-A describing complete Onan Line*

### D. W. ONAN & SONS

2114 Royalston Ave. Minneapolis 5, Minn.



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TWO QUICK SQUEEZES give you Finer, Faster Conduit Connections. B-M Fittings do away with the twisting, turning and tightening of nuts and save you valuable time and materials. Then too, they are stronger, neater and much easier to work with in tight places. Start using B-M Fittings today. Have more satisfied customers—more profits from each job! (All B-M Fittings carry the Underwriters Seal of Approval)

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The Steelduct Co., Youngstown, Ohio  
Enameled Metals, Pittsburgh, Penn.  
National Enameling & Mfg. Co., Pittsburgh, Pa.  
Triangle Conduit & Cable Co., New Brunswick, N. J.



**BRIEGEL METHOD TOOL CO. • Galva, Ill.**

(perhaps I should say all crane cabs concerned since more than two cranes could be involved). All cranes are 3 phase 220 volt with conventional trolley wire service, and they are all operated from a cab hung below one end of the crane. I would like to know if any reader can suggest a suitable control scheme that would warn the operators of approaching danger.—R.E.

**QUESTION P9**—We have a 440 volt, 3 phase bank of 25 cycle transformers connected closed delta on both primary and secondary. Our switchboard busses are fed from these with two 750,000 cable paralleled for each phase. Each of these cables is about 12 feet in length and the one with which it is paralleled is about 1 foot longer. We get the following amperage reading per phase:

Phase 1 1st cable 260 A  
2nd cable 320 A  
Phase 2 1st cable 280 A  
2nd cable 330 A  
Phase 3 1st cable 280 A  
2nd cable 320 A

These transformers are all 25 cycle, 200 kva., Type H, Form KDD. We are using these on 60 cycle. Why do each of these cables which go to the same bus or phase have such a difference in amperage reading? Does the difference of 1 foot in length account for this? —H.W.

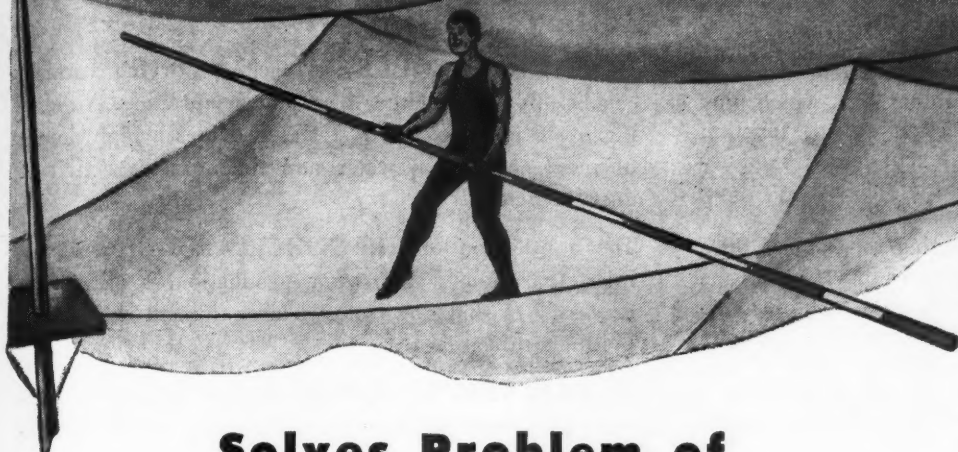
**QUESTION Q9**—On a flywheel load driven by a 220 volt d-c motor, shunting the main switch results in burning out of 110 volt lamps on the underloaded side of the 3 wire Edison system. What can be done to remind workers that they must pull the motor switch before they pull the main switch?—H.S.

**QUESTION R9**—I would like to use a single phase motor on a small lathe and have it so connected to a control whereby I could easily reverse the motor's speed (that is full speed in one direction to full speed in the other). If it can be done, then what type of single phase motor would you suggest that I purchase, and in what manner would the reversing be done?—E.J.K.

**QUESTION S9**—I want to build an auto transformer with 220 volt primary, 5 amps. primary current and voltage taps to be taken off at 210, 200, 185, 165 and 150 volts. How should this auto transformer be designed?—F.H.S.

**PLEASE SEND IN  
YOUR ANSWERS BY MAY 1**

**flexibility of control**



## **Solves Problem of Fuse Expansion and Contraction**

The same quality of balanced control that serves the high-wire artist in overcoming performance hazards, makes possible the efficient action of Jefferson Renewable Fuses in defeating hazards of accurate fuse performance—heat, cold, and moisture.

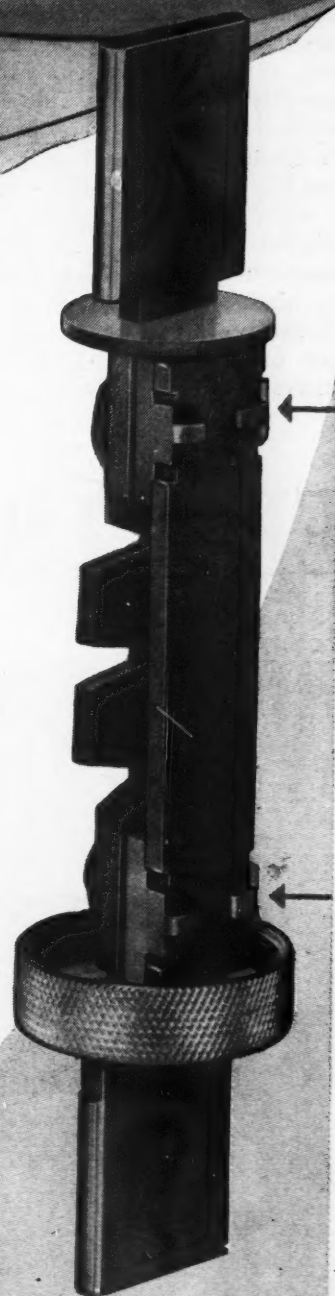
This principle of control is incorporated in Jefferson Renewable Fuses by an ingenious new construction feature. Knife blades are securely held in alignment yet the supporting "bridge" is allowed enough flexibility of motion to control and correct any tendency toward expansion or contraction. Consequently unbalanced strains and buckling are avoided.

Other *control* values built into a Jefferson Renewable Fuse include a link design that encourages heat dissipation, accurate calibration, and minimizes pressure developed on short circuits; also well proportioned brass ferrules and caps which quickly dissipate heat and reduce heating of fuse holders or switch blades.

All these technical advantages are evidence of the superior engineering, maximum efficiency, long life and economy of fuse performance available to all who specify Jefferson-Union Renewable Fuses. JEFFERSON ELECTRIC COMPANY, Bellwood (Suburb of Chicago), Illinois. *In Canada:* Canadian Jefferson Electric Co., Ltd., 384 Pape Avenue, Toronto, Ont.



**JEFFERSON  
UNION**  
*Renewable*  
**FUSES**



Above illustration reveals new flexibility feature which allows "bridge" to compensate for contraction and expansion.

**JEFFERSON  
ELECTRIC**



## MOTOR MAINTENANCE—*Today's Important Factor*

**N**OW, more than ever before, it is extremely necessary that the electric motors, generators, etc., which play such a vital part in our production set-up, function smoothly and efficiently. This equipment cannot be easily replaced . . . preventive steps must be taken to prolong its life and guard against burnouts and failures.

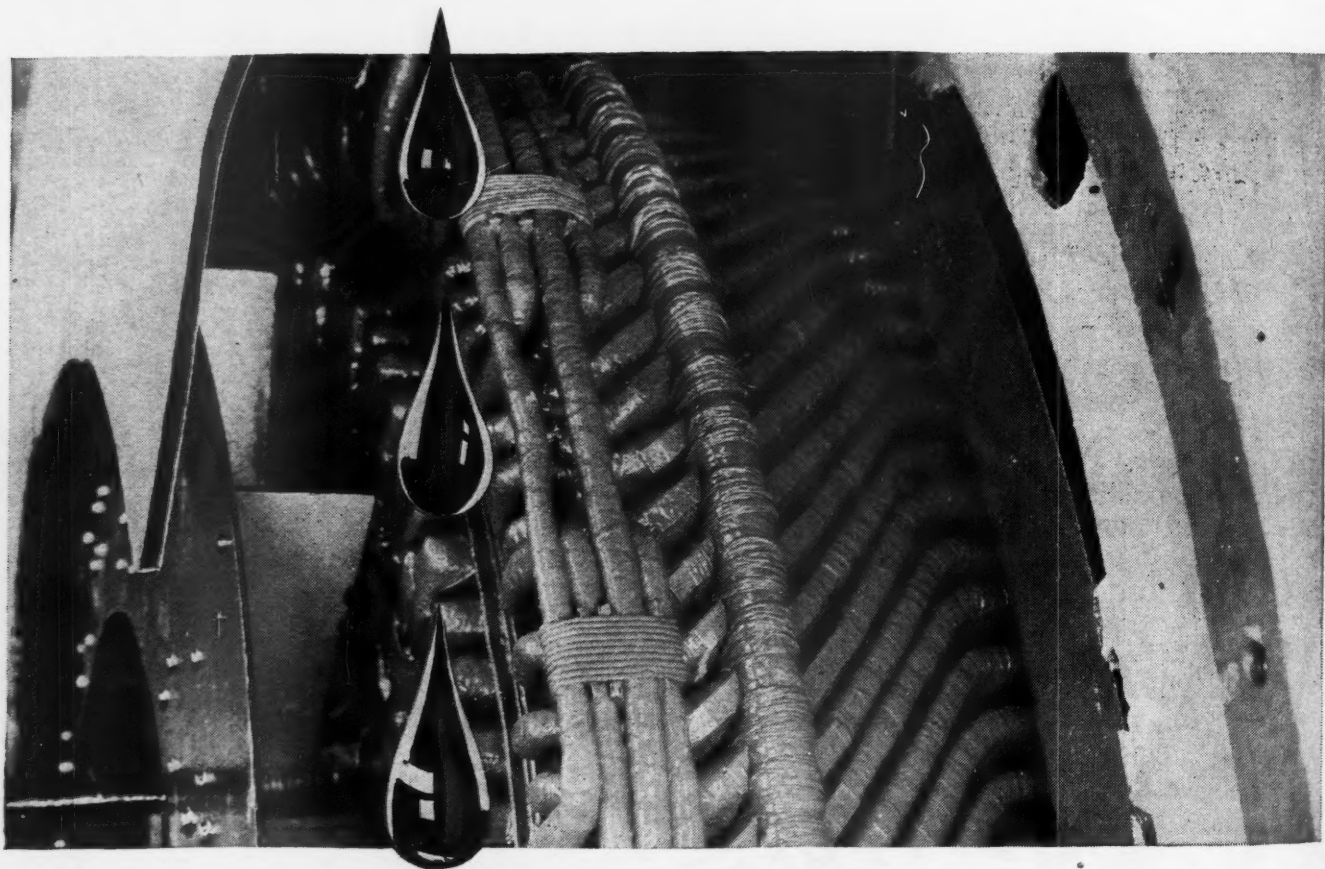
One of the prime factors contributing to motor failure is worn insulation. Holes and cracks develop in the original insulation . . . acids, oils, moisture and carbonaceous particles slowly break down the varnish film on windings . . . yet, this condition is quickly and efficiently overcome by renewing this insulation with a coat of DOLPH'S ELECTRIC LACQUER at regular intervals.

**ELECTRIC LACQUER**, a black air drying varnish, can be applied by either brushing or spraying. Air drying in 30 minutes, this material provides a high degree of resistance to oil, water and the abrasive action of dust particles.

The application of **ELECTRIC LACQUER** will not interfere seriously with your production, for it is not necessary to shut down electrical equipment except during the application process.

Let **ELECTRIC LACQUER** aid you in your preventive maintenance work, as it has for many others throughout industry.

# ELECTRIC LACQUER \* (TRADE MARK REGISTERED)



*Insulating* **Dolph's** *Varnish Specialists*  
**JOHN C. DOLPH COMPANY**  
168 EMMETT STREET • NEWARK 5, N. J.

# MOTOR SHOPS

## APPROVED METHODS SAVE MATERIALS TIME AND SPACE

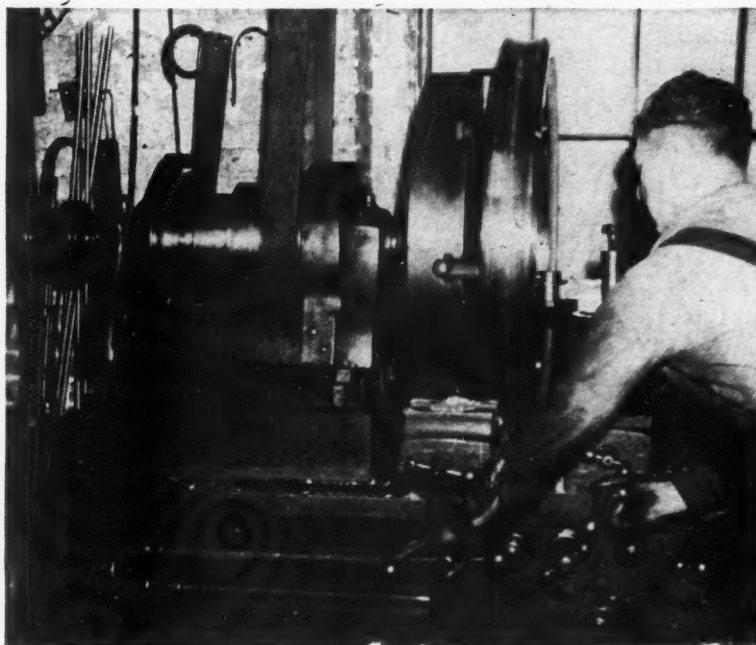
Accepting and applying recognized and approved safety features, ingenious make-shift process ideas, labor saving practices and space reducing arrangements are characteristics of the many motor shops where the customers' dollars secure maximum return. The Flynn Hill Elevator Corporation of New York City follows many of these time-tested practices, giving to each one individual variations for specific purposes.

A safety feature worthy of note is a self-closing, fire confining cleaning cabinet. Motors and parts to be cleaned are placed in the waist-high tank and saturated with a grease and oil liquid solvent pumped through a flexible steel hose from a reservoir located in the base of the tank. The solvent, dripping from the motor, flows by gravity through a filter and returns to the reservoir for recirculation by a self-contained, enclosed pump. Hinged to one edge of the tank is a metal cover, held open by a fusible link with a melting point of 280 degrees F. In the event of a local fire occurring in the tank, the link dissolves, the cover drops due to its own weight and the fire is confined. In the absence of combustion-supporting oxygen the life of the fire is brief and damage is at a minimum. Non-inflammable solvents are available for cleaning purposes.

Local light over lathes and millers has formerly taken the form of suspended or rigidly positioned incandescents. A standard Dazor floating fixture holding twin 20-watt fluorescent tubes can be bolted to the travelling tailstock of a lathe for constantly maintaining the light source over the point of operation. Multiple tubes eliminate possible stroboscopic flicker, the linear light source gives flatter illumination without pinpoint highlighting glare from the curved working surface and the pantograph action of the floating fixture allows rapid adjustment, positioning or removal.

On the subject of lathes; it is well to remember that raising the stocks from the bed plate increases the allowable diameter of work to be turned. By installing riser blocks a bronze gear rim, larger in diameter than the capacity of a belt-driven lathe, can be turned true prior to machining the gear teeth.

Storage space for armatures can be



*Headstock of belt-driven lathe is raised from bed plate by means of shop-designed riser blocks. Designed capacity of lathe is increased to handle large gear rim in turning operation.*

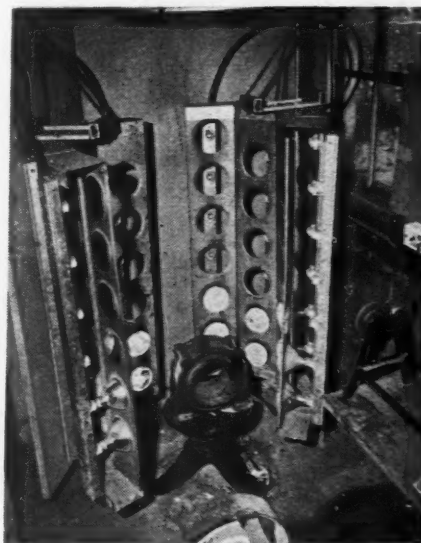
reduced by erecting 2- by 10-inch wooden studs on centers sufficiently separated so that the shafts of the largest armatures handled will overlap adjacent studs. One foot lengths of 1- by 1/4-inch steel are bolted to the studs, so located that protruding crotches are spaced vertically along each stud at 18-inch intervals. Armatures are hung on these hooks one above the other and the required floor space is minimized. Smaller armatures with shorter shafts are also hung on these racks by slipping short sections of pipe over the shaft ends to extend the shafts the required distance.

Safety features, time and space-saving ideas all tend to reduce overhead by cutting insurance premiums, labor per job and space rental. Keen competition makes these conservations imperative.

## INFRA-RED STACK FOR SHOP BAKE OVEN

Motor windings are baked with infra-red heat at the motor service department of the Electric Service Company, Ann Arbor, Michigan. But, unlike the conventional arrangement where the lamps usually form a horizontal "tunnel," these lamps are positioned so that, when

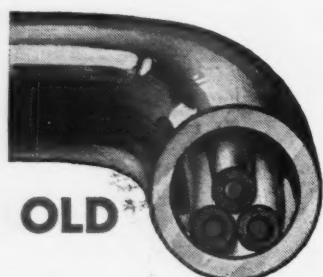
in operation, they form a vertical stack. Outstanding feature: the varnish fumes generated during the baking do not pass over the lamp wiring troughs but rise upward and are rapidly drawn off by the exhaust duct directly overhead.



*Vertical stack arrangement of infra-red lamps for baking operations at the motor repair department of the Electric Service Company, Ann Arbor, Michigan. Left bank of four strips is on a hinged background. Stator is on motor-driven turntable. Lamps are added as size of work increases.*



# CRESCENT SYNTHOL TYPE T



**OLD**

3 No. 12 Type R Carry 20 Amps.



**NEW**

3 No. 8 Type T Carry 41 Amps.

*Allows Larger  
Capacity On  
New Installations  
and  
Permits **DOUBLE THE**  
**AMOUNT OF COPPER**  
in  
**Existing Raceways***

Illustration  
shows  $\frac{1}{2}$ " conduit

Under present conditions there is urgent need for an economical and quick way of adding to the current carrying capacity of branch circuit conduits already installed. Increasing numbers of electrical appliances, air conditioning units and other equipment call for greater load on these branch circuits.

A simple solution to this problem is to replace present wiring with CRESCENT SYNTHOL Type T (formerly Type SN), which offers an easy and low-cost way approximately to double the current carrying capacity of the existing raceway.

An even greater increase in carrying capacity can be secured by wiring with CRESCENT Type TW in place of lead covered cable in wet locations.

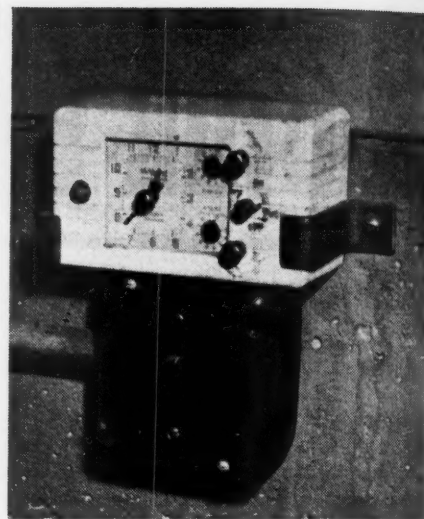
**Write for Descriptive Folder on  
SYNTHOL Type T and Type TW**

**CRESCENT INSULATED WIRE & CABLE CO.**

**TRENTON, N. J.**



**CRESCENT**  
**WIRE AND CABLE**



*An old electric kitchen range clock is the automatic timer controlling the banks of infra-red lamps. Connected in the clock circuit is the exhaust fan motor (directly over the lamps) which goes on and off with the lamps.*

The baking stack consists of eight strips (six lamps per strip) of infra-red lamps, four on each side, on hinged mountings adjustable so each group of four strips can be positioned to form a semi-circle. The four-strip bank on the right (see photograph) is mounted to a stationary support. The bank on the left is mounted to a hinged back-board so the "stack" can be opened to insert the work.

At present the circuits are so connected that all lamps are controlled by a single switch. For small motors and parts, only the lower three or four tiers of lamps are used. The other sockets are left empty. If a long armature—or vertical rack of small parts, as is planned—is the job at hand, additional lamps are placed in the vertical strips. The work to be baked is placed on a motor-driven turntable (13 inches above the floor) rotating at about 25 rpm.

Automatic control is affected through the use of an electric timer from a discarded electric range. The clock, formerly used to time the housewife's roasts, is now used to control the bake time for rewound motors. The clock circuit is so connected that when the contactor is closed, both the heat lamps and the exhaust motor go on; when the contactor opens, both go off.

## REEL RACK

The Dahl-Beck Electric Co., San Francisco, mounts wire reels on this novel reel rack for paying off to the winding machine. The frame is made of 2-in. angle iron, set on an incline. The upper edges of the side angles have slots cut in them about a 45 degree

# A WINNING HAND

IN THE  
ELECTRICAL GAME



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Ultimate mechanical, thermal and chemical protection.

Higher dielectric strength and longer life.

Uniform quality assured by laboratory control.

Performance proved by years of satisfactory service.

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# PAINE

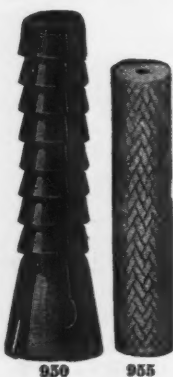
## Conduit Clamps



### Ease

### Buying • Installation and Maintenance

Designed for utmost convenience, Paine Conduit Clamps facilitate the hanging of pipe, conduit and cable. Each clamp is furnished with the correct size stove bolt already inserted, so that no time is wasted when you buy or install it. Special offset feature—that holds cable away from the wall—speeds installation and simplifies maintenance. Clamps are available in rigid or thin-wall sizes. All are guaranteed rust-proof.



## PAINE

### Woodscrew Anchors

#### Lead and Fiber, Types

The cheapest and best Anchoring Device available for fastenings in Tile, Marble, Concrete, Slate, Wood and Wood Furring.

Easy to obtain, easy to use. You simply place anchor in hole, insert woodscrew and tighten. No setting tool is needed and hole need not be plumb. Both lead and fiber types expand uniformly as screw is tightened assuring a firm fastening and a workmanlike job. Available in a wide variety of sizes.

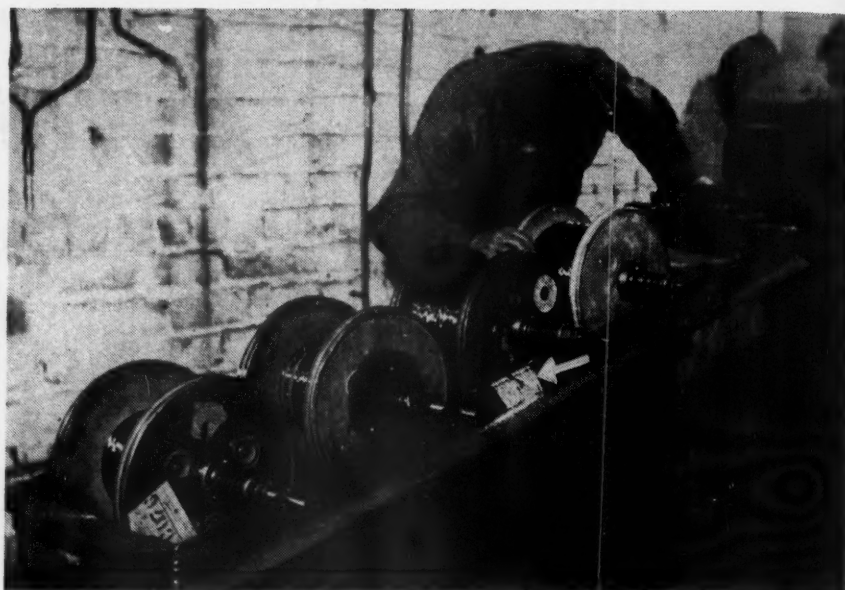
Ask your Supplier or write for catalog.

### THE PAINE COMPANY

2961 Carroll Ave.,

Chicago 12, Ill.

**PAINE**  
FASTENING  
and HANGING DEVICES



Reel rack with adjustable tension on each payout reel.

angle, see arrow in photograph. The reels are carried on mandrels, with squared ends which fit into these slots. The mandrels on the end next to the observer are threaded so that nuts can be drawn up against heavy springs seen on the mandrels. The inner ends of the springs bear against disks, which, in turn, press against the reel ends, the friction between reel ends and disks being regulated by nuts to give any desired tension to the wires as they come off. The reels themselves are mounted on ball bearings.

Two or more small reels may be run on the same mandrel. In that case, they are reversed, so as to draw off the top of one wheel and off the bottom of the adjoining wheel, the reel ends opposing each other. If both ran in the same direction, the friction between the faces might make the faster running reel spin the other and cause slack.

The length of the frame is approximately 6 feet and the width between side members is approximately 18 inches.

## CIRCULAR DRUM CUTS BAKING CYCLE

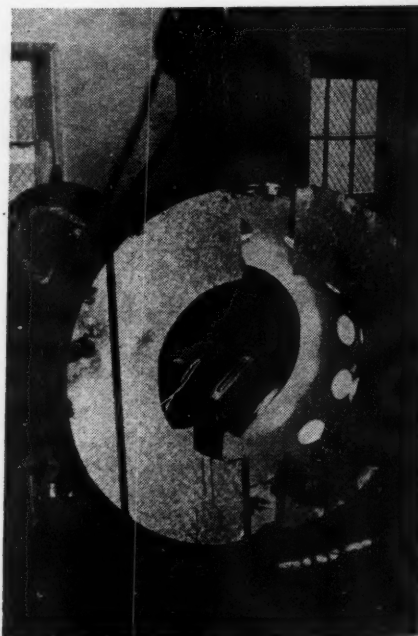
The utilization of a movable, shop-constructed baking drum has reduced motor baking periods to 25 percent of former requirements in the Aramingo Electric Company, Philadelphia, Pa.

The drum resembles a large, hollow, galvanized steel doughnut, open around the inner circumference and split vertically into two semi-circular halves. The drum has an outside diameter of 4 feet and a thickness of 18 inches. The diameter of the circular side openings is 2 feet. Each half is mounted independently on four 1-inch angle iron legs which serve the dual purpose of supporting and bracing the drum sec-

tions. Light in weight, the sections are easily and quickly movable to the location of the suspended motor where they are placed in position on either side of the equipment being baked.

Twelve 250-watt G. E. reflector drying lamps are mounted in either section, arranged in six groups of two, spaced on 10-inch centers. The average baking period is 4 hours—a decided reduction from the 16-hour span formerly required to obtain comparable results in a stationary, gas fired, fire brick lined oven.

Overhead monorails and a ½-ton Yale chain hoist facilitate raising the motor to the center height of the baking drum. The two halves of the drum are then placed around the suspended motor



Baked motor is suspended between two sections of shop-fabricated galvanized steel baking drum heated by 24, 250-watt reflector drying lamps. Lamp load of 6,000 watts completes baking cycle in 4 hours.

Wire for an ELECTRIFIED FUTURE with . . .

# HAZAKROME

Thermoplastic Wire



## Millions of Homes to be Built—Multitudes of Buildings to be Rewired

Lighting . . . heating . . . air-conditioning, yesterday's electrical luxuries have become today's standard practices. They are sure to become tomorrow's basic electric necessities, and they demand adequate wiring throughout. Every foot of wire now installed will be expected to serve far into the future.

When you check the advantages below, you can be sure that Hazakrome thermoplastic small diameter building wire contains all the qualities you could desire for every inside wiring job.

### Hazakrome saves during installation:

1. Less conduit space required
2. No saturants to drip and clog conduits
3. Lubricated surface for easy pulling
4. Free stripping to speed terminating
5. Tough — 2000 lbs. per sq. in. tensile strength

### Hazakrome lasts on the job:

6. Unaffected by air or sunlight
7. Non-flammable
8. Oil-resistant
9. Resistant to moisture and chemicals
10. Chemically stable and long-lived

### Hazakrome has operating advantages:

11. Operating temperature of copper — 60° C.
12. Greater current carrying capacity
13. High dielectric strength (over 700 volts/mil)
14. Resilient, resists injury and deformation

Hazakrome wires are available for shipping on short notice in all sizes and in a full range of non-fading, all-the-way-through colors. Hazard Insulated Wire Works, Division of The Okonite Company, Wilkes-Barre, Pa.

# HAZARD

insulated wires and cables  
for every electrical use

4518





Call  
  
 for  
**FLOODLIGHTS**

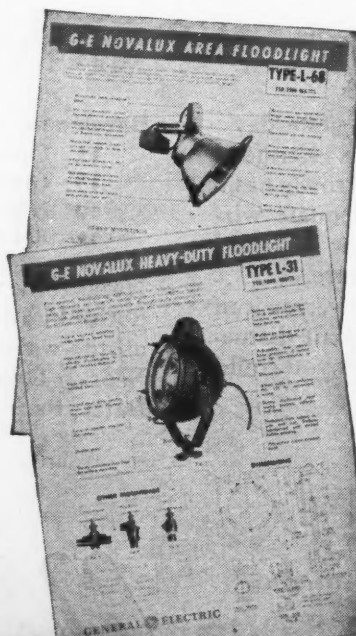
### ...and get these important advantages

- ★ Proper types and sizes for all applications
- ★ High-efficiency, the result of scientific design
- ★ Long life and low maintenance expense, obtained through sturdy construction
- ★ Expert assistance with application problems, backed up by 30 years' experience
- ★ Convenient sales and service facilities

#### WANT THESE HANDY DESCRIPTIVE LEAFLETS FOR YOUR PROPOSALS?

FLOODLIGHT	PUBLICATION
<b>Heavy-duty, steel casing</b>	
200 or 250 watts, Type L-29	GEA-4303
300 or 500 watts, Type L-30	GEA-4304
750 or 1000 watts, Type L-31	GEA-4305
<b>Heavy-duty, cast aluminum</b>	
200 or 250 watts, Type L-38	GEA-4325
<b>General purpose, sheet aluminum</b>	
300 or 500 watts, Type L-49	GEA-4311
750 or 1000 watts, Type L-43	GEA-4310
<b>Sports and area, sheet aluminum</b>	
750 to 1500 watts, Type L-68	GEA-4333
<b>Area, open porcelain enamel</b>	
300 to 1500 watts (Type L-45)	GEA-4433
(Type L-46)	GEA-4432
<b>Handy, sheet aluminum</b>	
200 watts, Type L-66	GEA-4346
<b>Underwater</b>	
100/250/400 watts (Type L-33)	GEA-4438
500/1000/1500 watts (Type L-41)	GEA-4439

Order individually by number, or in sets, from the G-E Apparatus Sales Office or Agent that serves you. Or write General Electric Company, Schenectady 5, N. Y.



**GENERAL  ELECTRIC**

### PISTOL GRIP WIRE GUIDE

E. Bacon, of the Atlas Electric Engineering Co., San Francisco, uses a wire guide for hand winding that is made of  $\frac{3}{4}$ -in. wood and shaped like a pistol. The wires pass through a hole in



*Pistol grip wire guide used in the shop of the Atlas Electric Engineering Co.*

an extension above the grip, along the top of the "barrel" and then down and out through another hole at the "muzzle."

He finds this easy to work with as compared with thrusting the whole hand through the stator at each turn.

### SPARE MOTORS REPLACE HAND CRANKS

The tempo of repairing motors can be materially increased by ingenious use of spare motors to power formerly



**FIG. 1—**Slot insulation former is motorized by a high speed, fractional hp. motor, stepped down and coupled to the machine shafts by a belt drive and controlled through a foot switch. Having both hands free allows the operator to guide and replace the paper with increased accuracy and speed.



## ***Accessibility and Flexibility***

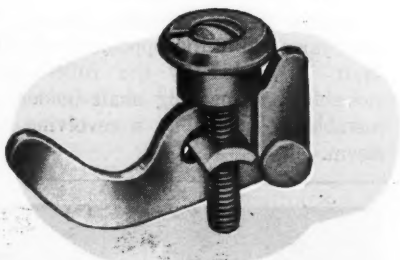
### **-AMONG THE ADVANTAGES OF WURDACK PANELBOARD DESIGN**

Wurdack Panelboards are designed to fit the needs of industry in reconversion and in the periods of expansion ahead.

The Wurdack basic design provides for easy, front accessibility for inspection and for maintenance of tumbler switches and fuse retainers.

Where plant alterations occur, flexibility is provided in Wurdack standard construction that enables changing from double to single circuits. This standardization permits a combination of pull switches to be added.

Wurdack Panelboards are manufactured in standard and special types for any size of industrial operation.



For ease of cabinet trim installation, the toggle clamp automatically grips the cabinet flange—the trim screw washer indicates the position of the toggle clamp. Only a screw driver is needed for installation.

***Reserve your copy of the new  
Wurdock Fusible Panelboard Catalog***



**WM. WURDACK ELECTRIC MFG. CO.**  
4444 CLAYTON AVENUE      SAINT LOUIS 10, MO.



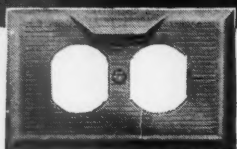
**NOW—YOU CAN  
EQUIP ALL SWITCHES  
AND OUTLETS WITH**

**LUMINITE**

REG. U. S. PAT. OFF.

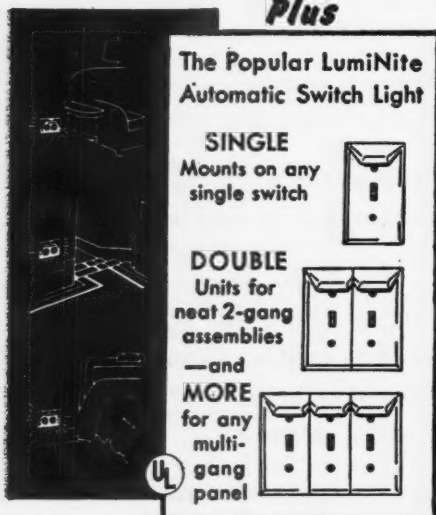


**NEW**



**ELECTRICALLY LIGHTED  
CONVENIENCE OUTLET PLATE**

**Plus**



LumiNite scores again with this attractive new electrically lighted duplex convenience outlet plate! It combines all the advantages of a permanent, ever-ready night light and a "wall-plug illuminator" that makes outlets easy to find and plug into!

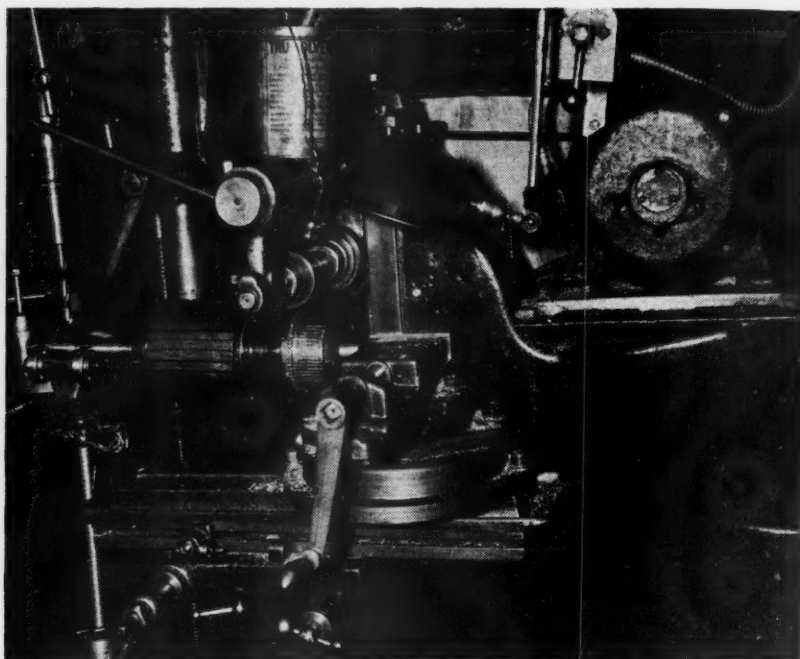
LumiNite features a tiny neon glow lamp, sealed within the beautifully molded housing of rich ivory plastic. It operates for less than 2c per year, lasts for years without a burn-out, and is backed by the LumiNite unconditional service guarantee!

In design, beauty and service, this new lighting convenience matches the popular LumiNite electrically lighted switch plate.

In design, beauty and service, this new lighting convenience matches the popular LumiNite electrically lighted switch plate. Easily installed on any standard duplex outlet. Sold nationally, by leading distributors and dealers. Write for details.

**ASSOCIATED PROJECTS CO.**

80 East Long St., Columbus 15, Ohio



**FIG. 2—Hand miller is powered by a two-speed motor. Capacity of miller has been increased by shop-milled riser plate beneath head jaws. Movable and adjustable roller shaft holder acts as rotating fulcrum for shaft.**

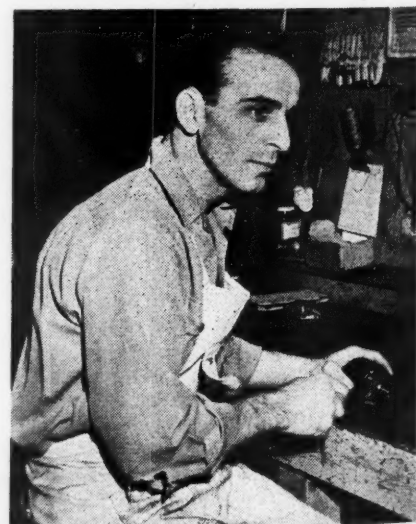
hand operated equipment. Activating electric controls through pressure on a foot pedal leaves both hands free to guide or move the work, lift equipment or make notes. Hand cranks no longer are seen in the shop of the Consolidated Electric Motor Repair Company of New York City because all rotational machines have been fitted with sheaves, spare motors and controls.

Motorizing the familiar and useful Ideal insulation former is one of several illustrations where spare motors are saving time and improving the quality of the finished products, Fig. 1. A  $\frac{1}{2}$  hp. motor with a speed of 1700 rpm. was stepped down to 125 rpm. and, through a belt drive with a 2-to-1 ratio, it transmits 250 rpm. to the shafts of the insulation former. A foot pedal controls the operation. With hands free to guide and replace the paper, operators report that slot insulation for a complete armature rewinding job is quickly and neatly formed. Rubber friction wheels guide the paper beneath the two hardened steel creasing rollers which form the insulating paper into a sharp U-shaped trough. Troughs up to  $1\frac{1}{2}$  inch are obtainable. Using the U-shaped trough takes full advantage of the maximum dimensions of the armature slots, the lining remains uniform, coil winding is speeded.

Motors have also been coupled to old coil winding machines, formerly powered by hand cranks, and man-hours consumed in this process have been cut in half.

Still another motor application is connecting a two-speed motor to a Pratt-Whitney hand miller used for milling out slots of small armatures. The motor

( $\frac{1}{2}$  hp. at 600 rpm. and  $1\frac{1}{2}$  hp. at 1800 rpm.) rotates the milling wheel which is raised and lowered by a control lever. The capacity of the miller has been increased by raising the head jaws off the bedplate by means of a shop-milled, 12-inch diameter, 2-inch thick riser plate, drilled and bolted as illustrated in Fig. 2. The armature shaft at the commutator end is held between the head jaws while the opposite end of the shaft is guided by the rollers of a movable, ball bearing shaft holder, adjustable in height by a revolving jack worm.



**Dan Cornila, superintendent of Electric Service Co's motor repair department at Ann Arbor, Mich., uses his 14 years of motor winding experience to good advantage. Before coming to Electric Service Company he was in the Panama Canal Zone, repairing motors for the government.**

# Are Heating Profits Slipping Through Your Fingers?

## READ THESE FACTS ABOUT THERMADOR ELECTRIC HOME HEATING

Outstandingly different, supremely modern and rich in advantages over ordinary heating systems, Thermador electric heating provides a newsworthy story for both you and your home-owner customers.

### THERMADOR ELECTRIC WARMTH IS CLEANER, PURER, SAFER

Thermador units offer the incomparable benefits of electric warmth in any room you desire. That means clean, pure, fumeless warmth...warmth that doesn't consume the vital oxygen in the air nor leave dust and film and smudges on the draperies, furniture and walls. For in electric heating nothing's added, nothing's removed. Room air is passed over an electric element, heated and spread over the living zone to give healthful, luxurious warmth.

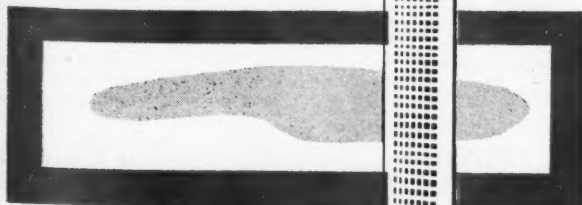
And it means safe, anxiety-free warmth...warmth that is derived from heating units that are fully protected with no exposed flames to blow out or to tempt curious little fingers.

### THERMADOR ELECTRIC WARMTH IS MORE ECONOMICAL

Thermador electric heating is a decentralized system. Each room has one or more independent units operated either manually or thermostatically. These units are compact, prefabricated...fit snugly into any wall between ordinary struts with a minimum of construction. No costly flues, chimneys or pipes are needed...no cellar space is required. They are as adaptable to a home being remodeled as to one being built anew.

Since each unit is operated independently, there's no central heating plant to be turned on during the seasons when just a little added warmth is required for a particular part of the home. Just a flip of the switch and baby's nursery, the bathroom or den is quickly warmed...without wasting precious heat over the entire house.

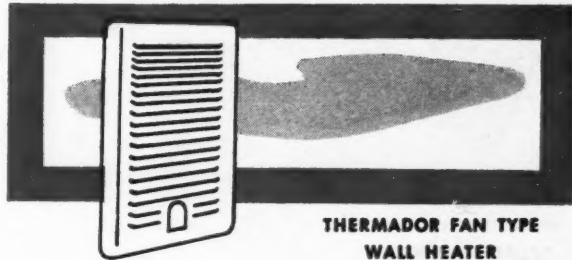
### THERMADOR ELECTRIC HOME HEATING IS FAR MORE EFFICIENT



THERMADOR HEAD-TO HEELS BATHROOM HEATER

Thermador utilizes new, original applications of electric heating principles to provide a maximum of heating efficiency. Consider the famous Thermador Head-to-Heels Bathroom

Heater. Unconventional in appearance?...Yes, and far more effective in the way it warms. For the Head-to-Heels is a tall, slender, handsomely finished unit that fits flush into any



THERMADOR FAN TYPE WALL HEATER

bathroom to provide instant, *overall* warmth. Its unusual design is no accident...but a scientific development that Thermador originated for greater bathroom heating efficiency.

And for every room in the home there's the equally famous Thermador Fan Type Wall Heater. Just as the Head-to-Heels employs a greater radiant length for quicker, overall warmth, so does this Fan Type Heater present a new and different application for the job it is designed to perform. Built into the unit is a fan that *forces* a gentle stream of clean, warm air out and down into the living zone.

### MAKE THIS TEST

Stand in front of an ordinary convection heater. You'll hardly feel the warmth. Yet place your hand above it and you can feel the heat rushing up to the wasted areas near the ceiling. Now stand in front of a Thermador...enjoy the caressing warmth that is forced out by the fan all over the living zone. What's more, in summer, switch off the heating element and the fan itself circulates cooling breezes throughout the home.

Thermador electric home heating offers you an outstanding opportunity for additional profits. Whether your customers are building or remodeling, it will pay you to tell them about Thermador electric heating. For further information, write, wire or phone Dept. EC-4.



THERMADOR ELECTRICAL MFG. CO. • 5119 District Blvd., Los Angeles 22



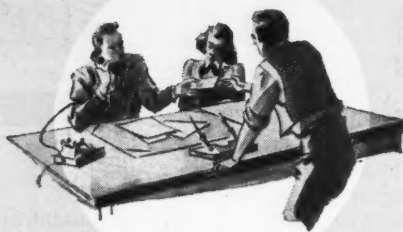


# New Complete Line of MITCHELL COMMERCIAL LUMINAIRES

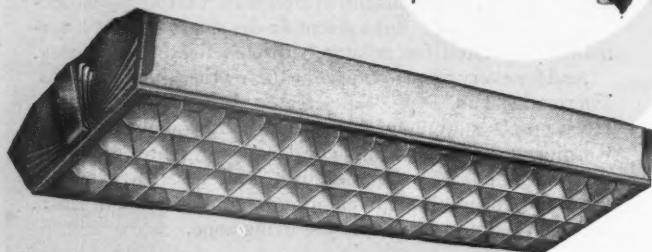
Broadens Your Lighting Service!  
Strengthens Your Leadership in Your Market!



For  
STORES  
OFFICES  
SCHOOLS  
PUBLIC BUILDINGS



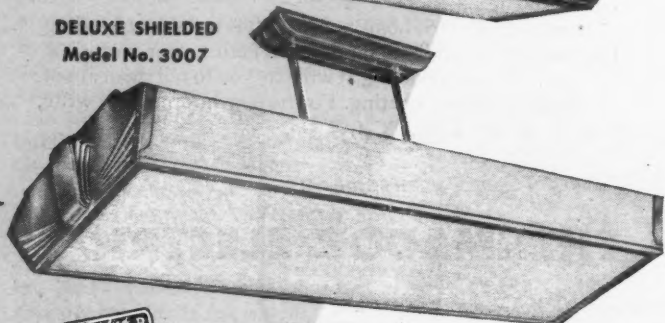
DELUXE LOUVERED  
Model No. 3011



SHIELDED UNIT  
Model No. 3004



DELUXE SHIELDED  
Model No. 3007



## New Designs! New Features!

### Answer Every Commercial Lighting Need

You have *everything* in the new complete MITCHELL line . . . to give you the lead in your market. For MITCHELL Fluorescent Luminaires offer every aid to lighting efficiency . . . and more value per dollar. They help you render a broader, more complete lighting service. They open up new fields . . . multiply your prospects! Twelve important features include exciting new modern designs in 2-light and 4-light units . . . glass-shielded, louvered and open types . . . Instant-Start . . . new patented "One-Man Quick Mount" . . . economical maintenance. Back of it all, stands the nation-wide acceptance of MITCHELL Products. That gives you today's *strongest selling line*. That makes doubly sure for you volume sales and profits in the great new lighting market.



#### Get New Catalog No. 285

Illustrates and describes the complete line of Commercial Luminaires. Includes helpful lighting data and servicing information. Write for it now.

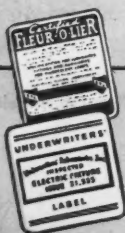
#### See Our Catalog in Sweet's

For convenient reference, Mitchell Commercial and Industrial units are cataloged in Sweet's 1946 Architectural and Mechanical Industries Files.

### Mitchell Manufacturing Company

2525 CLYBOURN AVENUE, CHICAGO 14, ILLINOIS

West Coast Factory and Sales Office: 1019 N. Madison Ave., Los Angeles 27, Cal.



Visit the MITCHELL exhibit at the International Lighting Exposition at the Stevens Hotel, Chicago April 25-30, Booths No. 69, 70 and 71.



#### MAKERS OF

Commercial and Industrial Fluorescent Lighting Equipment • Store Window Lighting • Spotlights and Floodlights • Desk Lamps • Portable Floor and Table Lamps • Bed Lamps • Ultraviolet and Infrared Health Lamps • Residential Lighting Specialties.

THESE ANNOUNCEMENTS of new equipment are necessarily brief—for more detailed description, sizes, prices and other data write to the manufacturers' advertising departments, tell them in what issue of **ELECTRICAL CONTRACTING** you saw the item and they will send full details to you.

# EQUIPMENT NEWS

## Fluorescent Unit

A new two, three and four recessed fluorescent lighting fixture has been developed. It features a "Telescopic" frame that fits flush to the ceiling. The unit is available in either the egg crate or the honey comb styles. Special piano hinges and "quick-slide" catches have been designed so that all electrical component parts are accessible without dismounting the fixture. It uses the 40 watt fluorescent lamps. All-Bright Electric Products Company, 3917 N. Kedzie Ave., Chicago 18, Ill.



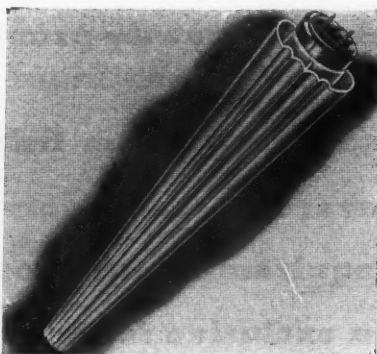
ALL-BRIGHT FLUORESCENT UNIT

## Carbon Brushes

The 8800 series is an addition to this line of high speed electrographitic brush grades. They are known as Grade Link EG/8870, Link EG/8866 and Link EG/8880. The "open" texture permits close contact with the commutator. Link EG/8870 is the closer textures and Link EG/8880 is the more open of the three, with Link EG/8866 falling between. Morganite Brush Company, Inc., 3302 48th Avenue, Long Island City 1, N. Y.

## Plastic Diffuser

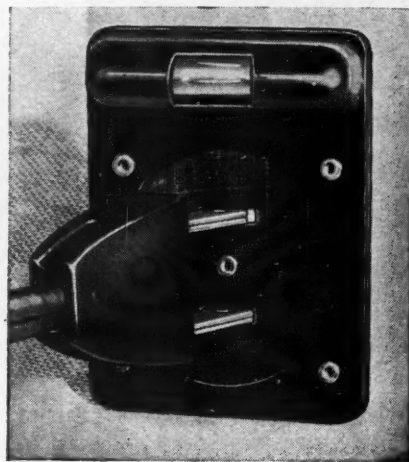
The New PFC-100's, "4-Foot" white plastic diffusers have been developed. They snap on or off 40 watt (T12) fluorescent lamps, reduce lamp brightness 30 percent but are claimed to be more efficient than glass diffusing panels. Unit has a spring-like patented design that grips the lamp along its entire length to afford easy cleaning and relamping. Snug-fitting diffusers help shield lamps and confine heat of lamp itself for more consistent operating temperatures. The Edwin F. Guth Company, 2615 Washington Ave., St. Louis, Mo.



GUTH DIFFUSER

## Pilot Light

A plug-in pilot light known as Handi-Glow, is for standard electric outlet or socket. Wafer-thin, this neon-light indicator takes the usual plug prongs slipping through its slots and into the standard electric outlet or the female plug. Protected by a metal housing, the neon bulb is over the head of the plug. The device is intended primarily

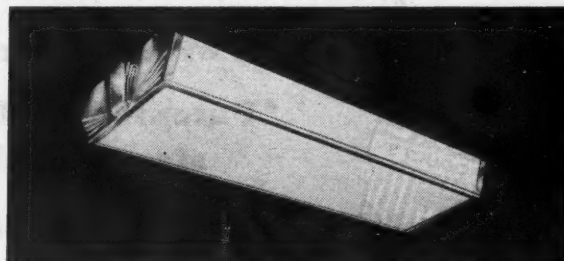


PILOT LIGHT

for use with any standard 110 volt a-c or d-c outlet. It is useful with soldering irons, electric heaters, toasters, percolators and other appliances that may be used on switch-controlled circuits, or with plugs that should be pulled out when the equipment is inoperative. Industrial Devices, Inc., 22 State Road, Edgewater, N. J.

## Commercial Units

New 2-light and 4-light commercial fluorescent luminaires in regular and instant-start models have been designed for stores, offices, schools and public buildings. Light is diffused with two double-strength ceramic treated side panels and one double-strength prismatic ribbed glass bottom panel. Panels are easy to remove and clean. All-steel wireway channel and reflector. End plates of satin aluminum, with translucent luminous effect. Unit may be surface or suspension mounted, singly or in continuous rows. They operate on 110-125 volts, 60-cycle a-c. Higher voltages are available. Mitchell Manufacturing Co., 2525 Clybourn Ave., Chicago 14, Ill.

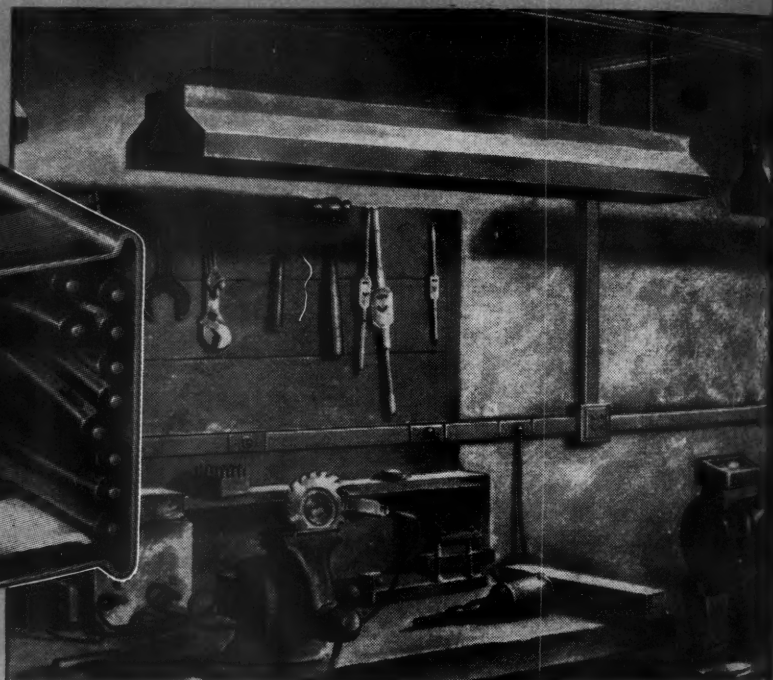


MITCHELL COMMERCIAL UNIT



# NATIONAL ELECTRIC

# Surfaceduct



## All PURPOSE ELECTRICAL RACEWAY

- New 2x2 Surface Raceway provides a clear channel for maximum wires
- Lay-in feature—pioneered by National Electric—no fishing of wires
- Sturdy, flexible, accommodates over 300 manufacturers' devices
- Serves every electrical requirement up to 60 amp. loads
- Patented bridge—an exclusive feature—provides strong anchorage for capping and fixtures.



Complete engineering data on request

**National Electric**  
PRODUCTS CORPORATION  
Box 897—Pittsburgh 30, Pa.

## Fuse Puller

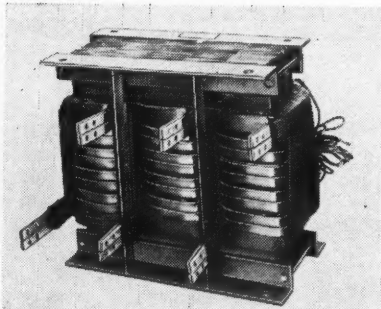
A new pocket type fuse puller for those who handle cartridge fuses has been announced. It eliminates danger of shock when handling live cartridge fuses or other live electrical parts. It takes the most popular sizes of cartridge fuses up to 200 amp. in 250 volts and 100 amp. in 600 volts. Puller has five laminations for strength and durability. Size is  $7\frac{1}{2}$  inches long,  $1\frac{3}{8}$  inches wide. The blade clamp permits adjustment of fuse clips which may have spread. Eagle Electric Mfg. Co., Inc., 2310 Bridge Plaza South, Long Island City 1, N. Y.



EAGLE FUSE PULLER

## Rectifier Transformer

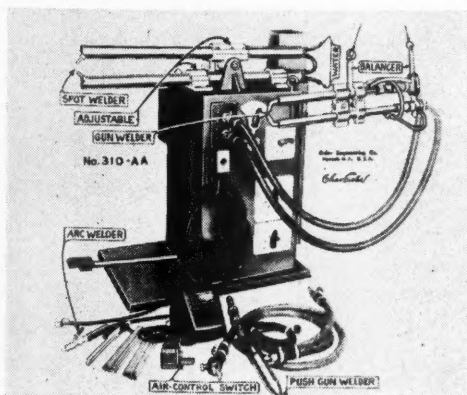
This new line of rectifier transformers has been improved in design. It is for use in the field of electroplating rectifiers but also recommended for battery charging and other types of large rectifiers. Due to insulation, air is only cooling medium. Tapped primaries are provided to give a flexible secondary voltage and current range. Multiple secondaries and other special variations can be had to meet individual requirements. Available sizes range from 500 va. to 500 kva., single and three phase and in all standard frequencies. Marcus Transformer Company, 32-34 Montgomery Street, Hillside 5, N. J.



MARCUS RECTIFIER TRANSFORMER

## Spot Welder

This Universal spot welder is especially suited for spot welding all types of sheet metal work. In addition, the unit can be used with a hand operated push type and tong type gun welder, and for a-c arc welding (100-400 amps.) The gun welder can also be supplied with air operation. One of the features is the deep throat provided by both horns which can be lengthened or shortened by sliding them in the bearings to fit the size and type of sheet metal



EISLER SPOT WELDER

work to be welded. The kva. rating of the welders can be from 20 to 50 kva. at the shortest throat depth. The horns as well as the tip holder and tips are water cooled. The machine is available for air as well as foot operation. Wiring permits independent operation of spot welding and arc welding. Unit can be supplied either with mechanical or all electronic type timer and contactor. Eisler Engineering Co., 750 South 13th St., Newark 3, N. J.

## Drill-Bits

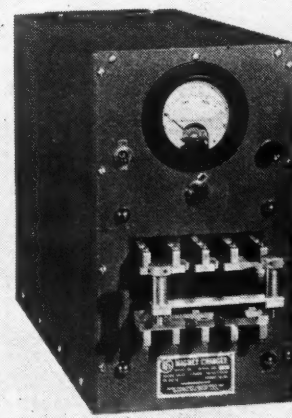
This new carbide tipped cyclone drill-bit is used for drilling holes in concrete, cement, brick, tile, marble, and other forms of masonry material. Drills are made in stock sizes starting at  $\frac{3}{16}$  inch, up to and including  $1\frac{1}{2}$  inch diameter, by sixteenth. They are used by electricians, plumbers, air-conditioning installation men, maintenance men in industrial plants, sign-hangers and steam-fitters. Also by machine shops for drilling chilled iron, and for cored holes in aluminum, cast iron and other types of non-ferrous materials. The New England Carbide Tool Company, 60 Brookline Street, Cambridge, Mass.



NEW ENGLAND DRILL-BITS

## Portable Magnet Charger

RFL Model 107 charger is designed for use in production lines, instrument repair shops, laboratories. It contains a condenser, an associated power pack and a current transformer through which the condenser bank is discharged. The transformer secondary is connected to a charging bar which is arranged for convenient association with the magnet for induction of the charging magnetic flux. The condenser charge is controlled by an ignitron type tube operated by a pushbutton on the front panel. The storage condenser bank has a capacity of 100 microfarads and is charged to approximately 500 volts. When the ignitron type tube is fired the condenser discharges in a small fraction of a second, producing a high current surge in the charging bar exceeding 15,000 amperes peak value. It is portable or may be bolted to a bench for production operations. It plugs into a 110/120 volt 5/60 cycle a-c service power outlet. Radio Frequency Laboratories, Inc., Boonton, N. J.



PORTABLE MAGNET CHARGER





## A picture that means more to **YOU** than a thousand words!

It doesn't take forever to tell men who *know* Fluorescent lighting why Certified Ballasts build good will.

Here's what the label stands for:

**Certified Ballasts are made to rigid specifications** set up by foremost lighting engineers . . . to assure better lamp performance . . . fewer service troubles.

**Certified Ballasts are E. T. L. checked.** Sample ballasts are thoroughly checked by Electrical Testing Laboratories, Inc., before they are **CERTIFIED** as meeting

the Specifications. And random samples are periodically rechecked at E.T.L. and at the factories.

**Certified Ballasts help assure top performance** in fluorescent lighting fixtures that use them. *Leading fluorescent tube makers will guarantee lamp performance when Certified Ballasts are specified in fixtures.*

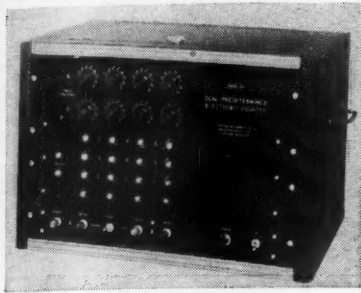
For new fluorescent fixtures or for replacement in existing equipment, protect your customers by specifying Certified Ballasts.

### Certified Ballast Manufacturers

*Makers of Certified Ballasts for Fluorescent Lighting Fixtures*

<b>CHICAGO TRANSFORMER CORP.</b> 3501 Addison St., Chicago, Illinois	<b>GENERAL ELECTRIC CO.</b> Specialty Transformer Section 1635 Broadway, Fort Wayne, Ind.	<b>JEFFERSON ELECTRIC CO.</b> Bellwood, Illinois
<b>SOLA ELECTRIC CO.</b> 2525 Clybourn Ave., Chicago 14, Illinois	<b>WHEELER INSULATED WIRE CO.</b> 378 Washington Ave., Bridgeport, Conn.	

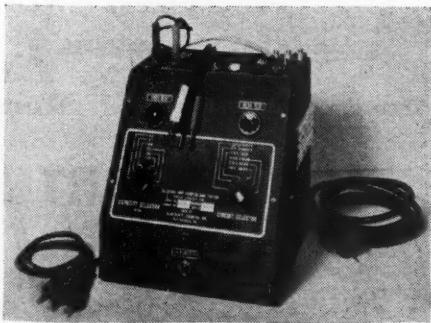
## Electronic Counter



**POTTER ELECTRONIC COUNTER** A new dual predetermined electronic counter for use where the counting and packaging of small items is to be accomplished. The instrument employs four of the standard Potter four tube counter decade circuits. These decades are arranged to give two independent predetermining channels in which any number from 0 to 10,000 may be initially set up by manipulating rotary switches mounted on the front panel. During the operation of the equipment each channel is alternately preset to the desired predetermined number. It operates on a 110 volt 60 cycle circuit. Units are available for any specified total count with either the single or dual predetermining channels. Potter Instrument Company, 136-56 Roosevelt Avenue, Flushing, N. Y.

## Test Instrument

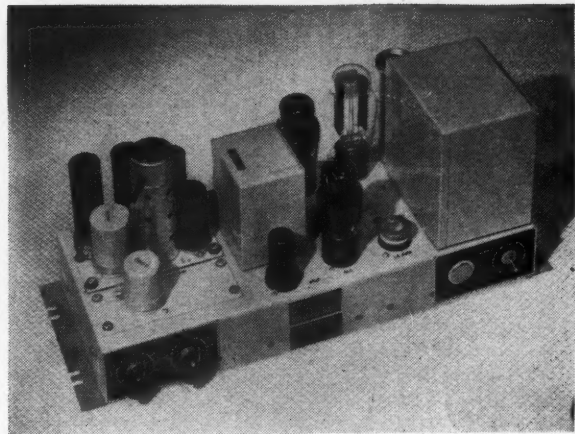
A unit starter and analyzer has been added to the Airserco line of instruments. This instrument will start both hermetic and open type units up to  $\frac{1}{2}$  hp. under actual working conditions. Electric motors with defective condensers, centrifugal switches, relays, or wiring may be restored to operation. Two multiple gang switches, in combination with a universal relay, employing calibrated weights, set up 56 individual starting combinations for correcting defects in hard starting units. When a unit is restored to operation by the analyzer, permanent repairs may be made by supplying a starting kit derived from the dial and weight readings. All components and circuits are utilized for other tests and checks. Aircraft Service Company, 435 Melwood Street, Pittsburgh, Pa.



**AIRCRAFT ANALYZER**

## Sound Amplifier

The new Type 108 amplifier series consists of a 20 watt medium to high gain mast power amplifier on which small input panels may be mounted and changed at will. This series can be used in sound systems, or in speech input applications as monitor or talk-back amplifiers. The 108 series consists of Types A, B, C and D. The Type A is designed to be employed as a high power monitoring amplifier and has a bridging and 600 ohm input; the B is a high

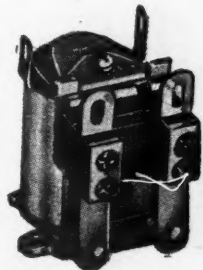


**LANGEVIN AMPLIFIER**

gain amplifier designed to operate from a source impedance of 30 to 250 ohms; the C is a combination of the A and B and the D supplies two high gain input stages. The Langevin Company, Inc., 37 West 65th Street, New York 23, N. Y.

## Control Relay

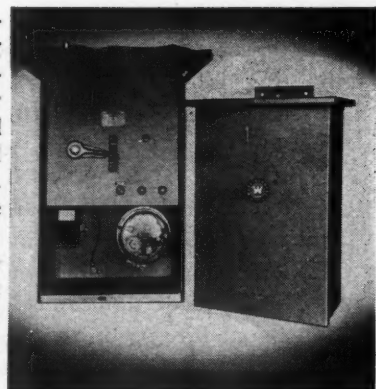
This new control relay is designated the "CR" type. It is claimed to be more efficient on precision application in industrial and special control circuits than larger and heavier power relays. Contacts up to  $\frac{1}{4}$  inch in diameter are obtainable. Unit is available in two, three and four pole combinations, and if desired, hermetically sealed. Contact rating with  $\frac{1}{4}$  inch silver contacts is 15 amperes at 24 volts d-c or 110 volts a-c, non-inductive. Allied Control Company, Inc., 2 East End Avenue, New York 21, N. Y.



**ALLIED CONTROL RELAY**

## Pumping Control

This new a-c magnetic oil field pumping control has been designed to provide for automatic starting and stopping of oil field pumping motors. Weatherproof enclosure permits outdoor, pole mounting close to the load. The dead front inner door protects the operator from live parts, when cabinet door is opened. Starters are available in two basic



**WESTINGHOUSE PUMPING CONTROL**

types, each providing overload and low voltage protection. The automatic unit includes AB breaker, "De-ion" line-starter, lightning arrester, hand reset low voltage relay, selector switch to permit manual operation, socket and time switch. Time switch automatically controls specific pumping periods during the day. Ratings are from 1 to 25 hp., 110, 220, 440-600 volts. Westinghouse Electric Corporation, Pittsburgh, Pa.





## INSTA-START Improves and Safeguards Your Fluorescent Lighting

The specter which can upset any planning for fluorescent lighting is Excessive Maintenance. Wherever excessive maintenance shows up, the whole fluorescent industry — manufacturer, contractor, utility — suffers a set-back.

FRANCE INSTA-START Fluorescent Transformer is an essential element in any properly designed and safeguarded fluorescent installation using 40 or 100-watt hot cathode lamps — as 90% of all commercial lighting will.

Hundreds of thousands of FRANCE INSTA-STARTS have gone into use in the past five years. Production is now at the rate of many thousands a week and is steadily increasing.



*Write for latest circular on INSTA-START Transformer*

### THE FRANCE MANUFACTURING COMPANY

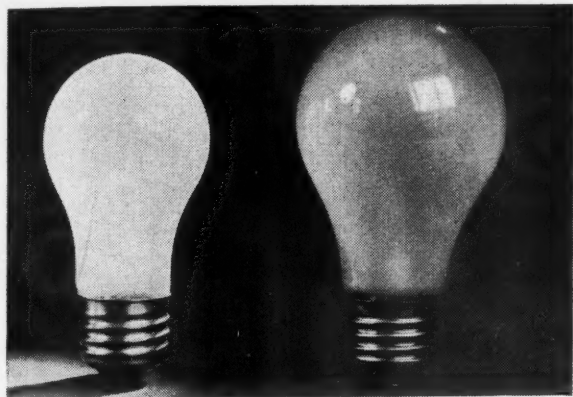
Manufacturers of INSTA-START Fluorescent Transformers and Franceformers for Neon Signs

10325 BERE A ROAD

• CLEVELAND 2, OHIO

## Refrigerator Lamp

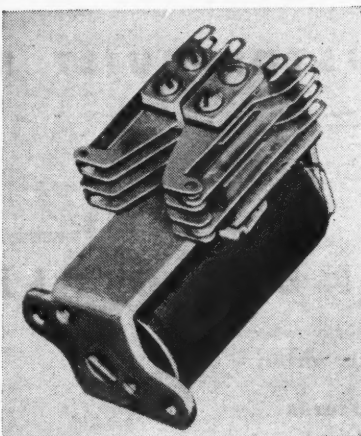
A 40 watt lamp, specially designed for use in mechanical refrigerators, has been announced. Its small size saves refrigerator space and reduces the cost of the lamp shield. It gives approximately the same light as the general service 40 watt lamp. The new lamp is inside frosted, has a medium screw base, is designed for 120 volts and has a rated life of 1,000 hours under specified test conditions. Lamp Department, General Electric Company, Nela Park, Cleveland, Ohio.



G-E REFRIGERATOR LAMP

## Multi-Pole Type Relay

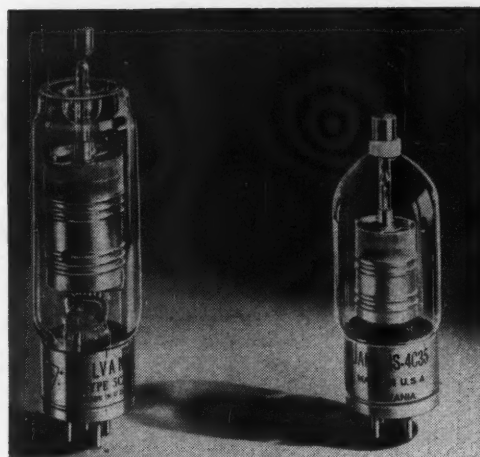
A new midsize a-c multi-pole relay with shunt coil for electronic and communication applications has been announced. Standard voltages range from 1½ to 220 volts, 60 cycle. Contacts are available in from one to four poles, normally open, normally closed or double break. The double throw contacts can be "break before make" or "make before break". Maximum contact rating-non-inductive, 3 amperes, 24 volts a-c; 1 ampere, 110 volts a-c. Coil rating is 11 volt amperes, inrush; five volt-amperes sealed. This relay is also available in single pole normally open double break contact, 10 ampere rating, at 115 volts a-c. Overall dimensions are 1-61/64 in. long; 1-34/64 in. high (four pole double throw); 1-35/64 in. wide. R-B-M Division, Essex Wire Corporation, Logansport, Ind.



R-B-M RELAY

## Hydrogen Thyratrons

Two new types of hydrogen thyratrons for industrial electronic and pulse communications service have been announced. Features of the new thyratrons include low deionization time; rapid switching rates; high peak currents; high plate voltages; operation over wide ambient temperature range; low tube voltage drop; and flexible operation in any position. Applications include pulse com-

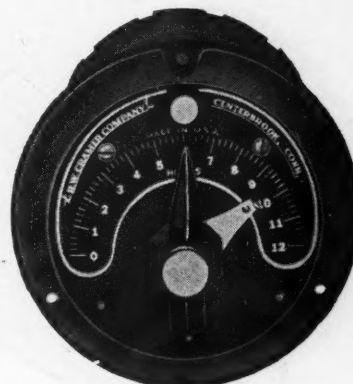


SYLVANIA THYRATRONS

munication, high speed welding, electroplating, electro surgery and high speed photography. Sylvania Electric Products Inc., 500 Fifth Avenue, New York 18, N. Y.

## Interval Timer

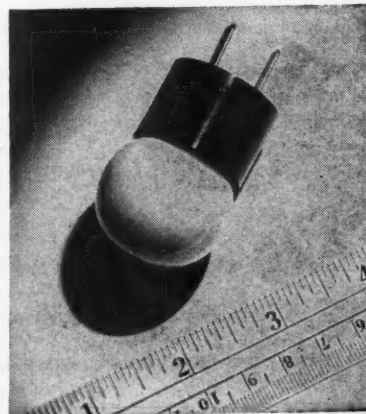
A new electric interval timer to control the running time of process equipment; to control duration of exposure, as in X-Ray machines; to close one circuit and open another at a predetermined interval or to operate signal after a certain time interval. Some of the features are larger dials designed for easy reading and easy setting; sturdier frame construction permitting greater precision in original assembly and simplified screw mountings. The R. W. Cramer Company, Inc., Centerbrook, Conn.



CRAMER TIMER

## Fluorescent Glow Lamp

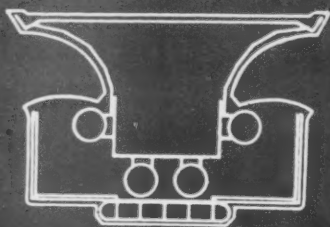
A new 1 watt fluorescent glow lamp, designed for use in any ordinary lamp socket or base plug, has been announced. The new walnut-size lamp is equipped with either a medium screw base or a prong type of base. The green lamp is recommended for hallways or bathrooms, or as a safety light at the head of stairs or in dark closets. The white lamp was developed primarily for bedroom night light service. Lamp Division, Westinghouse Electric Corporation, Bloomfield, N. J.



WESTINGHOUSE GLOW LAMP



# *The Aristocrat of* **FLUORESCENT LUMINAIRES**



**ORIGINALLY A CURTIS  
CUSTOM-BUILT DESIGN**

*Now*

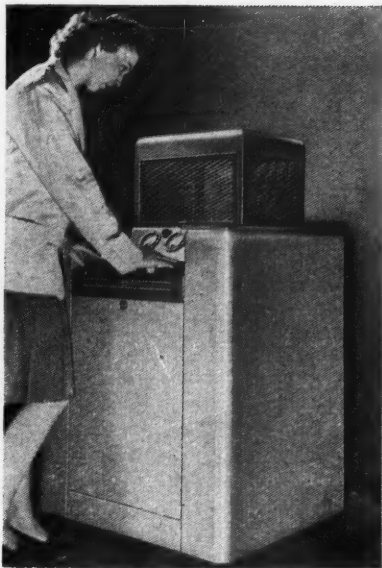
**AVAILABLE AS A STANDARD FIXTURE**

Few, if any, luminaires carry the unmistakable stamp of quality which characterizes Curtis No. 70610-XE. Whenever a quality job turns up, the phrase "originally custom-built" minimizes competition from low price units. The beauty of it is, that you can back up your sales story with facts about quality... appearance... construction and maintenance that justify its higher cost. Admittedly No. 70610-XE will never appeal to the mass market; it is, however, reasonably priced for the quality market. Made for four 40-watt fluorescent lamps, ideal for individual mounting or continuous rows as illustrated. **WRITE FOR SPECIFICATION SHEET TODAY**



## Dielectric Heater

This new standard 2 kw. output dielectric heater operates on a frequency of 27 megacycles, and is designed for simplicity of control and continuous industrial duty. Frequency can be varied through a wide range by a front panel control and an automatic timer controls heat sequence from two seconds to 20 minutes as selected. An oven, containing electrodes set for any desired application, is shielded to eliminate radio frequency radiation. Filament of a long-

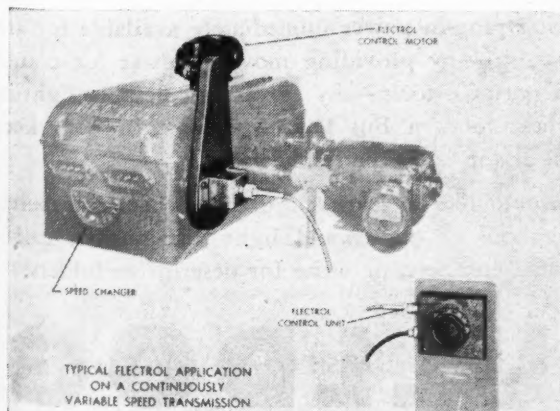


ALLIS-CHALMERS HEATER

life oscillator tube with forced air cooling is protected by a time delay relay. Added protection is provided by an overload plate current relay. Some of the applications recommended by the manufacturer are preheating for forging and curing of many types of plastics, gluing, drying and curing wood, processing of rubber and synthetic materials, sterilization of foods and medical supplies, drying and heat treating of textiles, processing of chemicals during manufacture, and defrosting frozen foods. Allis-Chalmers Mfg. Co., Milwaukee 1, Wis.

## Remote Control

"Flectrol" applied to commercial speed changers provides fingertip remote control of speed. The dial can be set to any desired speed and the speed changer will follow as fast as the electric servo motor can drive the speed adjusting screw. The dial can be calibrated in rpm., feet per minute, gallons per hour. In operation, Flectrol con-



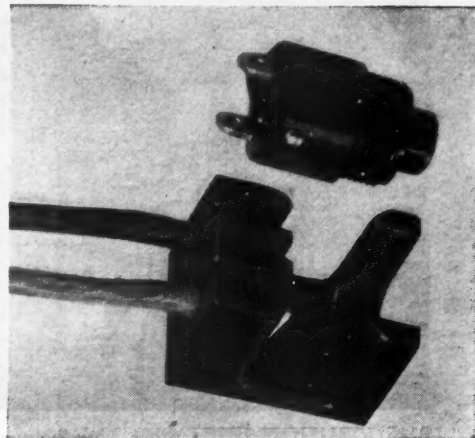
YARDENY FLECTROL

trols the rotation of the small motor used to adjust the pulleys or gears of the speed changer. Rotation of the speed selector dial causes this motor to drive the adjusting screw until the output speed of the controlled device corresponds

to the speed selected on the dial. Flectrol can also be built in or added to motor operated valves, machine tools, printing presses, conveyors or all equipment having motor operated adjustment. Yardeny Laboratories, Inc., 105 Chambers Street, New York 7, N. Y.

## Renewable Switch

This switch can be used in a single hole mounting and has two flat studs protruding out the back. Lugs frequently are attached to these. However, when the switch is used as a renewable type, the studs slide down between two contact bars which are in the back part of the cradle.



HETHERINGTON SWITCH

The front part of the switch slides down through a slot in the front part of the cradle. The cradle itself is attached to any flat surface by counter sunk screws. The device is a little over an inch long and three quarters of an inch high. At the present time only single pole single throw switches, either normally open or normally closed, can be furnished in this renewable type. Robert Hetherington & Son, Inc., Sharon Hill, Pa.

## Portable Wheatstone Bridge

This bridge is a compact instrument equally suited to laboratory, production or communication measurements. All contacts are enclosed. The limit of error for the ratio resistors is 0.05 percent. A cam switch with three positions sets the bridge for the various loop tests. The galvanometer is a replaceable unit provided with a clamp lock. Coil resistance is 250 ohms. Some of the

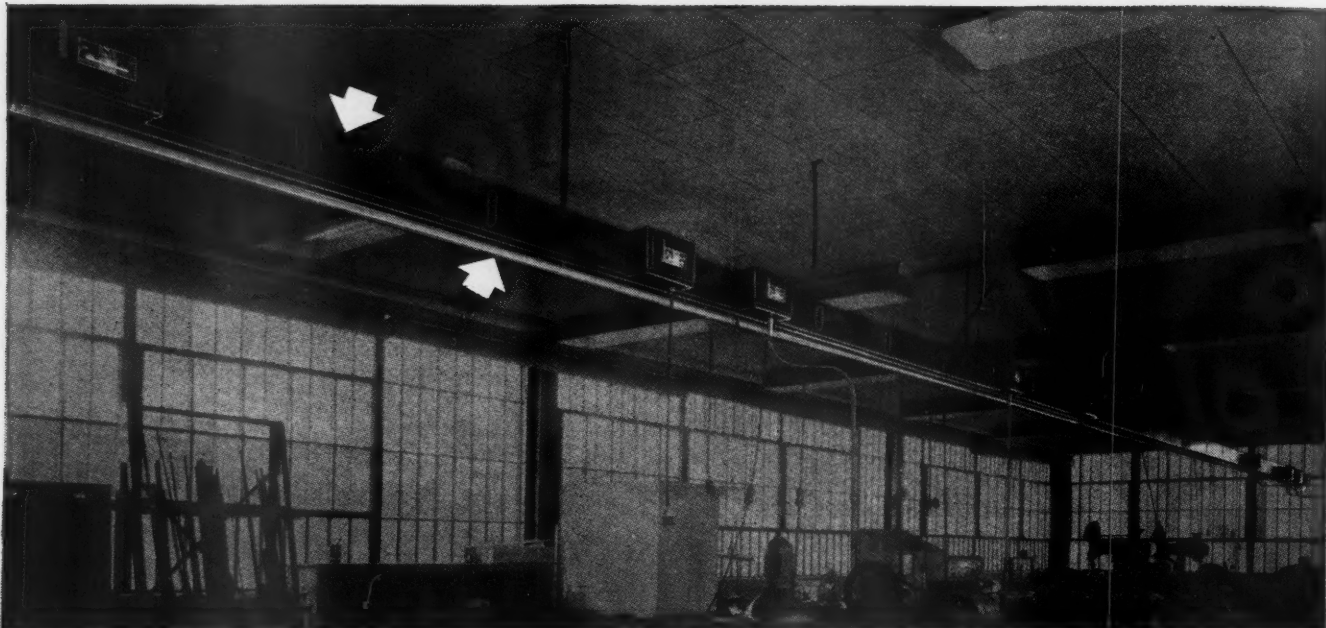


WINSLOW BRIDGE

features are positive contact; self-wiping switches; laminated blades; snap-lock dial positioning; self-contained or external battery. It measures 8 $\frac{1}{2}$ -in. by 7 $\frac{1}{2}$ -in. by 5 $\frac{1}{2}$ -in. The Winslow Company, 9 Liberty Street, Newark 5, N. J.



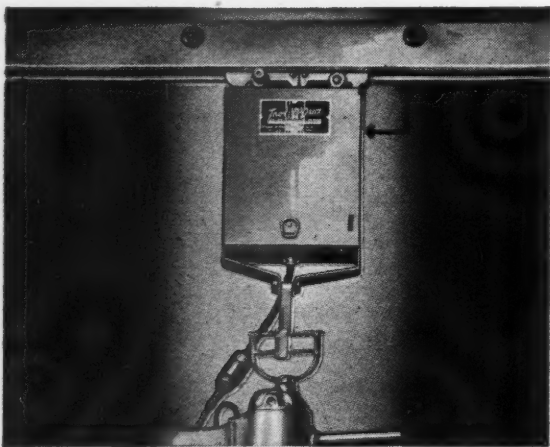
# VALUABLE *Time Saved!*



**BUSTRIBUTION DUCT** gives you "Plug-in Power" for any machine set-up.



**UNIVERSAL TROL-E-DUCT** gives you "Flexible Lighting" which permits you to add and move lights without rewiring, or make radical changes in the lighting scheme any time.



**INDUSTRIAL TROL-E-DUCT** gives you "Moving Power" for Portable Tools, Cranes and Hoists—easily and quickly installed for ready mobile power.

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The ease and speed with which Bulldog Electrical Distribution Systems can be rearranged or relocated—without material loss—is today saving countless hours and expense in the reconversion of thousands of U. S. industrial plants to peacetime production.

By making plug-in power immediately available for any machine set-up—by providing moving power for cranes, hoists and portable tools—by furnishing flexible lighting circuits, these modern Bus Duct systems will help keep production at top speed and efficiency.

If you would like to learn more about these completely flexible methods of power and light distribution, call a Bulldog field engineer, or write for descriptive folders.

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Detroit 32, Michigan. In Canada: Bulldog Electric Products of Canada, Ltd., Toronto. Field Offices in All Principal Cities.



Also Manufacturers of  
Vacu-Break Safety Switches—Soft-Fuse Panelboards—Switchboards—Circuit Master Breakers.

**BULLDOG ELECTRIC PRODUCTS CO.**

*Electrical Contracting, April 1946*

# QUESTIONS ON THE CODE

## REWIRING A FACTORY

**Q.** We are rewiring a woodworking factory and they have several new machines that are powered by seven individual motors. The largest motor is at 5 hp. and the total rating amounts to 12½ hp. They are all three phase, 60 cycle, 220 volt motors, and the instructions accompanying the machines state that these machines may be supplied by No. 8 conductors. The local inspector feels that inasmuch as the total motor load in amperes amounts to 38.9 amperes, the feeder size should be determined by adding 25 percent to the rating of the largest motor, which would mean a total of 42.65 amperes and would require a No. 6 conductor. Is the inspector correct in his assumption?—M.C.

**A.** If all motors on these machines may be operated at the same time, the inspector is correct in suggesting the use of No. 6 conductors. However, it is possible that the instructions furnished by the factory are based on the fact that the motors cannot be operated simultaneously and that it is only necessary to provide feeder capacity to supply the total rated requirements of the greatest number of motors that might be operated at any one time. Permission to do that is granted under Section 4316 of the Code.—G.R.

## A SERVICE QUESTION

**Q.** The present 220-100 volt service consists of a three pole 30 amp. main switch and line feeder is three No. 8 entrance cable.

Under the Code, is it permissible to change to a 60 amp. switch without changing to a larger size of entrance cable? Or can one use No. 8 wire for a 60 amp. switch?—A.Z.

**A.** The Code at present under an Interim Amendment, requires, and the 1946 Code will require, that a service switch will have a rating not less than the load to be carried as determined by Sec. 2203 (as for feeders).

Therefore if the feeder load as determined in accordance with the rules for computation of feeder loads is not greater than 30 amperes, the service switch may be rated at 30 amperes and the feeder conductors may be No. 8.

Of course the service switch may be larger than 30 amperes but if No. 8, R Type wire is used, the service fuse must not be larger than 35 amp. or not larger than the allowable carrying capacity of whatever type of wire is used. This also means that No. 8 wire may be used with a 60 amp. switch if the load is not over 35 amps.

Again service wires larger than No. 8 can be used with a 30 amp. service switch provided that the switch is not smaller than the computed load.—F.N.M.S.

## WIRING A FEED MILL

**Q.** We have wired a feed mill and are supposed to supply a 50 hp. motor to operate the hammer mill. So far we have been unable to find a dust-

tight motor of this size, and the owner is anxious to begin operation so he has asked us to get some other kind of a motor. Can we install a motor of other than the approved dust-tight type without violating the Code and jeopardizing our license privilege?—M.L.

**A.** The Code offers several alternatives in Class 2 locations. Under Section 5057 you will find permission to use totally-enclosed, totally enclosed fan cooled, totally enclosed pipe ventilated motors, or, if these specially constructed motors are not available, motors of any type providing they are enclosed in separate rooms or housings built of or lined with non-combustible materials, constructed so as to exclude dust and properly ventilated from a source of dust-free air.

If an ordinary motor is enclosed so as to exclude dust, considerable care must be taken to assure adequate ventilation to keep the motor from overheating. The vent pipes must be of metal substantially constructed, with each section connected to the next by means of rivets, bolts or by welding, and the outer ends must terminate in weather heads if outdoors, screened to prevent entrance of birds or animals.—G.R.

## INDUSTRIAL WIRING

**Q.** We are laying out the wiring for a new factory building which will be served by four wire three phase service. In order that the load might be balanced, we planned to run three wire multiple circuits using two phase wires and the neutral. It will be advantageous to run several of these multiple circuits through the same raceway for short distances, but the local inspector claims that we must consider the neutral as a current carrying conductor when determining the number of wires in each raceway. We had previously been advised that the neutral might be disregarded in the count of wires permitted in raceways.



**Frank K. Hanlin**, assistant electrical engineer, Underwriters' Laboratories, Chicago, tells Illinois electrical inspectors of the safety tests lighting fixtures go through at the Laboratory.



# **SORGE** *AIR-COOLED* **TRANSFORMERS**

*are* **UNIVERSAL**

Single phase units are interchangeable.  
460 or 230 volt primary.  
230 or 115 volt 2 or 3 wire secondary.

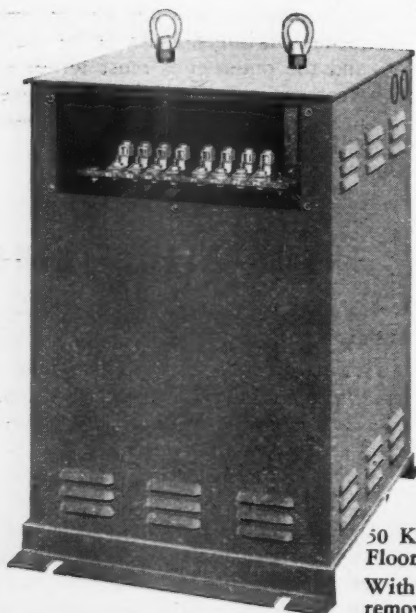
*are* **ECONOMICAL and  
CONVENIENT  
TO INSTALL**

**Mount on wall, post, or floor.  
No extra brackets required.**

**Convenient connection compartment.  
No extra junction boxes or fittings.**

**Enter primary or secondary on  
either side, or both on one side.**

**Connect to solderless terminals.**



50 KVA.  
Floor Mounting Type.  
With cover of connection compartment  
removed, showing solderless terminals.

*No Splicing  
No Soldering  
No Taping*

**A size and type  
for every purpose.**

**1/4 KVA. to 1000 KVA.  
All voltages.**

**Single phase  
and poly-phase.**

**SORGE ELECTRIC CO., 836 W. National Ave., Milwaukee 4, Wis.**

*Pioneers in the development and manufacturing of Air-Cooled Transformers*



*New Code rules are aired at Illinois inspectors' Chicago conference by (L to R) James Ryan and Art Daniels, Chicago city electrical inspection department; and R. G. Rowland, chief electrician, Eclipse Lawn Mower Co., Prophetstown, Illinois.*

*Can you explain the Code requirements on this problem?—J.D.*

**A.** In a three wire circuit consisting of two phase wires and the neutral taken from a four wire three phase system, the common conductor or neutral will carry 1.41 times the load carried by the phase wire supplying the greater load. Therefore a neutral under such a load must be considered as a current carrying conductor. This will be found in the fine print note under item 6 on page 304 of the N. E. Code.

Usually a multi-wire branch circuit consisting of three conductors is single phase, and the neutral is required to carry only the unbalance of load and can never carry more than the load carried by one of the ungrounded conductors. To do that the other ungrounded conductor must be under no load so the neutral need not be considered as a current carrying conductor when determining the carrying capacity of more than three conductors within raceways. In other words, four multi-wire three conductor branch circuits of the single phase type or three multi-wire three conductor branch circuits of the two phase type may be placed within a common raceway. In either case the ungrounded conductors could be loaded to 70 percent of the current carrying capacity of each conductor as shown in Table 1.—G.R.

## **NON-METALLIC SHEATHED CABLE**

**Q.** *In a non-metallic sheathed cable job must I use a three wire cable so as to have a grounding wire to ground outlet boxes and fixtures to?—C.B.*

**A.** Not necessarily. Metal outlet boxes may be used with non-

*Electrical Contracting, April 1946*

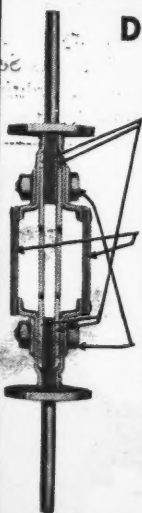
LOOK TO THE FUSE LEADER FOR PRODUCTION PROGRESS

*Cool!*

THE BEST COOL OPERATING FUSE - DESIGNED BY WARE

**WARE**  
HI-LAG  
*Renewable*  
**FUSES**

### *Cool Facts No. 2*



#### **DOUBLE BRIDGE ASSEMBLY**

Spring tension, double contact area on link.

Links centered in all casings.

Double Fibre Bridge for Alignment and Strength.

Screws Locked—Only one wrench needed.

Insert either end in Casing. Minimum of parts.

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### **The Fuse That Science Built Cool to Prevent Excessive Heating During Heavy Current Loads and Long Service**

When you make that next fuse installation, consider the World's Best and Coolest Operating Fuse—try WARE HI-LAG.

You will then see for yourself how the WARE HI-LAG stays cool under conditions that ordinarily cause overheating—you will see why it's good business to standardize on a product that ends costly delays—needless production shut downs and interruptions.

There's higher lag for motor starting overloads—stronger lag for operating current surges—lower contact resistance, reduced heating and larger and stronger terminal connections.

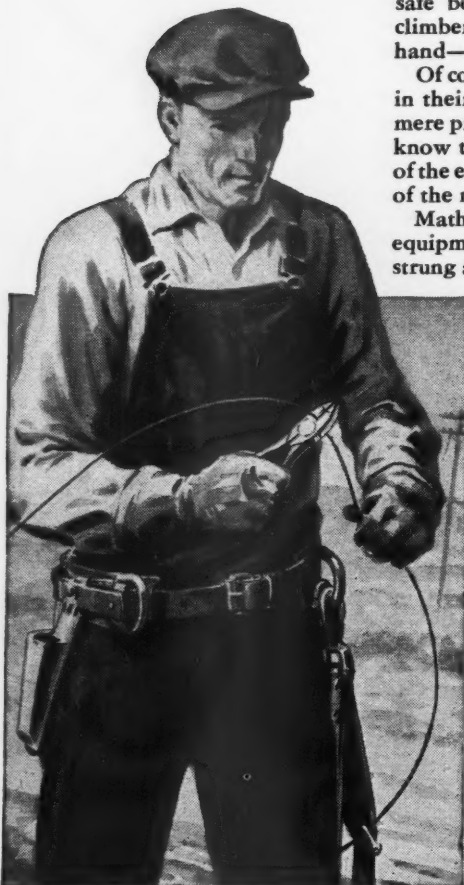
The double-bridge assembly at left is another cool construction feature, helping to lower contact resistance and excessive heating.

*Write for Brochure giving details of all the COOL FACTS, sizes and prices.*

**WARE** *Brothers* 4450 W. LAKE ST. · CHICAGO 24, ILL.



# Every Lineman a KLEINMAN



When you see a man on a pole, it's a pretty safe bet that his safety strap and belt—the climbers strapped to his legs—the pliers in his hand—are Kleins.

Of course these men take a craftsman's pride in their tools and equipment. But more than mere pride makes linemen prefer Kleins. They know that their life depends upon the quality of the equipment they use—the experience back of the maker of that equipment.

Mathias Klein and Sons have been producing equipment for linemen since the first wires were strung and today this equipment owes its high quality to the same handcraftsmanship methods—the same individual inspection and testing on which Klein reputation has been based "since 1857."

While today's demand exceeds production and all users cannot be supplied as rapidly as we would like, your supplier will furnish genuine Klein equipment as soon as he can.

## ASK YOUR SUPPLIER

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The Klein Pocket Tool Guide showing the Klein line and containing useful tables and information will be sent without charge.



No. 5204KK—Klein-Kord tool belt. Uniform quality assures maximum safety. Construction permits tongue buckle. Made in all sizes.

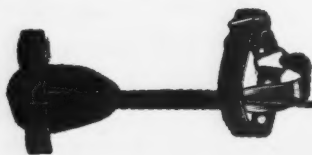


No. 5233 Klein-Kord safety strap. Made of multiple plies of long staple cotton, specially woven and vulcanized in rubber. Uniform strength throughout. Red center gives positive warning of wear.

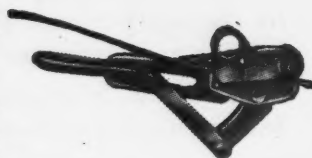
No. 201-NE side cutting pliers. Made in 5, 6, 7, 8 and 9 inch sizes. One of a complete line of pliers for every electrical need.



No. 1901-M Climber. Standard weight for maximum strength. Made in all sizes. One of a complete line of Klein climbers.



No. 1628-5BH Klein Chicago Grip. One of the complete line of Klein Grips. Made of forged steel with bronze lined jaws. Patented safety latch prevents falling off wire—may be applied close to pole and slid out required distance. Ideal for hot line work.



metallic sheathed cable and in general these do not need to be grounded.

However, equipment, such as outlet boxes, panel boxes, fixtures, etc., which is in contact with metal lath or other metal, or in a wet location and also metal fixtures within reach of bath tubs, shower baths, plumbing fixtures, steam pipes or other grounded metal, must be grounded.

Where such equipment is to be grounded this may be accomplished by means of an extra wire in the cable assembly, insulated or otherwise, or by some other means.

In no case can the grounding be done by connecting the equipment to the neutral conductor.

It may also be accomplished by a separate grounding conductor run to a water pipe.

The last sentence of rule 2612a shows that this connection may be made to the nearest water pipe rather than having to run to the water service entrance.

Of course such connections would have to be accessible so that the Inspector could be sure that proper connection was made.—F.N.M.S.

## BRANCH LIGHTING CIRCUITS

**Q.** We are planning the rewiring of a school building and are in doubt as to the proper method of arriving at the number of branch lighting circuits. Inasmuch as fluorescent lighting fixtures will be used, is it necessary to consider each outlet as equivalent to five amperes?—C.B.

**A.** In determining the number of branch circuits required for a school building, it is necessary to consider the area to be illuminated as Section 2108 states that general lighting shall consist of a load of not less than 3



New chairman of Illinois Chapter, IAEE, E. E. Dodds (left), Chicago, receives congratulations and gavel from retiring chairman L. E. Ewald at recent Chicago conference.

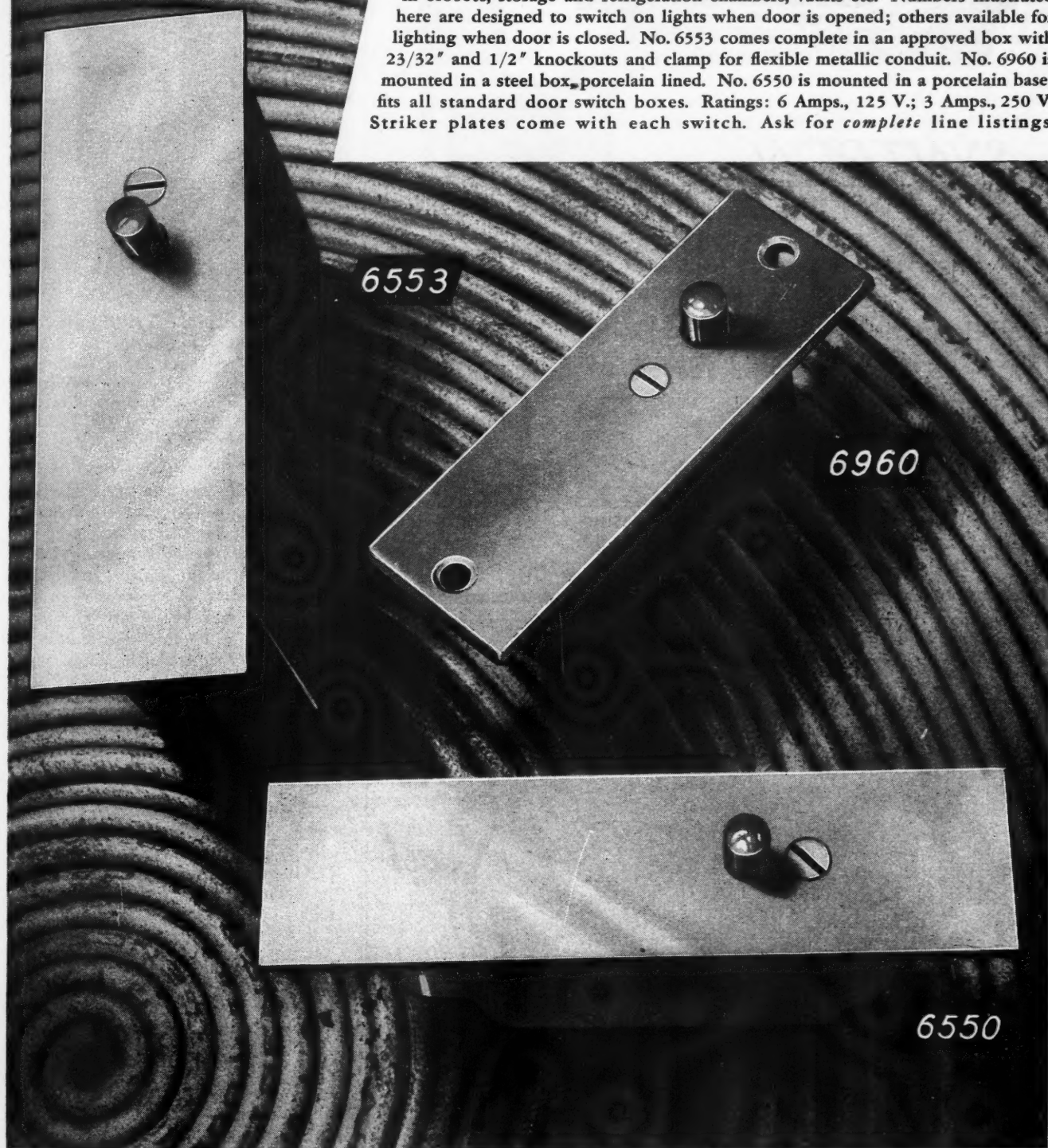
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Established 1857 Chicago, Ill., U.S.A.

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# ARROW DOOR SWITCHES

Automatically control the lights by opening and closing of doors as in closets, storage and refrigeration chambers, vaults etc. Numbers illustrated here are designed to switch on lights when door is opened; others available for lighting when door is closed. No. 6553 comes complete in an approved box with  $23/32$ " and  $1/2$ " knockouts and clamp for flexible metallic conduit. No. 6960 is mounted in a steel box, porcelain lined. No. 6550 is mounted in a porcelain base; fits all standard door switch boxes. Ratings: 6 Amps., 125 V.; 3 Amps., 250 V. Striker plates come with each switch. Ask for *complete* line listings.



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THE ARROW-HART & HEGEMAN ELECTRIC COMPANY, HARTFORD, CONN., U. S. A.





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*Texas' contribution to NECA officialdom (L to R) Charles Scholibo, manager, Southeast Texas Chapter, Houston; M. T. Dorsett, manager North Texas Chapter, Fort Worth; and George A. Seaman, NECA field supervisor, Fort Worth.*

watts per sq. ft. Then under Section 2107 we also find another requirement which limits the load to be placed on a circuit carrying continuous loads to 80 percent of the branch circuit rating. Therefore a 15 ampere circuit would supply an area of not more than 440 sq. ft., a 20 ampere circuit will cover 533 sq. ft., etc. These are minimum figures and may not furnish adequate lighting. If you will notice the last sentence under Section 2108-a you will see that sub-paragraph d of this section is applied only to occupancies not listed under this section. When occupancies not listed are to be wired, outlets supplying heavy duty lamp-holders shall be considered as requiring a minimum of 5 amperes per outlet, and the definition of a heavy duty lamp-holder is found under Section 2112.—G.R.

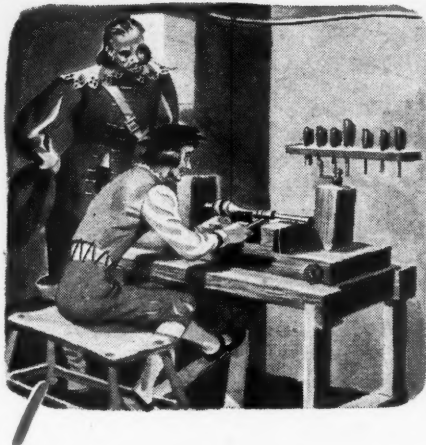
### BUS DUCT INSTALLATION

**Q.** I am installing some bus duct in one of the factories here and some insurance inspector has advised the owners that all vertical runs that extend from one floor to another must be provided with some kind of a damper at each floor. I have hunted through Article 364 covering busways and can find nothing concerning such a requirement. Is this some special insurance rule?—L.H.

**A.** No, this ruling is part of the N. E. Code and may be found under Section 3286. The ruling is as

Old Reliable Red Band Says—

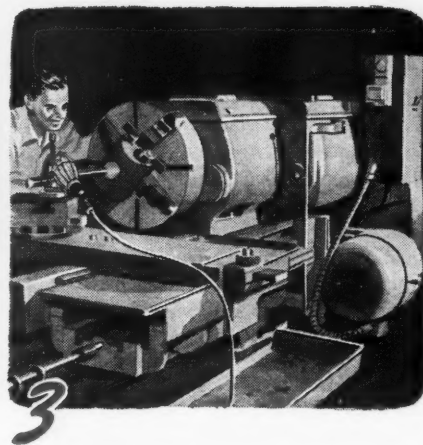
*"They used to 'Boot Out'  
Machine Tools!"*



In the early 1600's, machine tools like this for making metal items were considered marvels. They were tricky to use. Foot power replaced laborious hand work. Crude machine tools for making metal items were literally "booted out!"



By accident, in the 1870's, it was discovered that if a direct current dynamo was connected to the current of another, that the first would serve as a motor. This ushered in a new age—the age of utilization of electrical horsepower.



Result: Electrical horsepower replaced foot power! Today, every plant uses from dozens to thousands of electric motors . . . For more than a quarter of a century Howell has specialized in building quality motors for a wide range of industrial uses.

## Have you a hard job for horsepower?

Years of specializing in building industrial type motors to meet the exacting requirements of the automotive, machine tool, dairy, food and other industries, have enabled us, we believe, to make Howell Motors better than ever.

Today, as always, Howell Motors are quality-motors. They are smooth operating because they are statically and dynamically balanced. They are better performing because they are built of the finest materials—copper or bronze rotors—and

completely insulated. They are trouble-free on the job because they are designed for the toughest tasks in industry—consequently, they perform better on all jobs.

For your needs, in specialized or standard motors, from  $\frac{1}{4}$  to 150 h.p., phone the nearest Howell Representative today. Remember, you pay no more for industrial type Howell Motors . . . but you always get top quality for your money.



Howell Protected Type Motors available in sizes 5 h.p. and smaller. Also other sizes of Howell industrial type motors available up to 150 h.p.



# HOWELL MOTORS

HOWELL ELECTRIC MOTORS CO., HOWELL, MICH.

Manufacturers of Quality Industrial Type Motors Since 1915



follows: "If floors are pierced, suitable cutoffs against the vertical travel of fire shall be provided." This is a definite requirement to guard against the spread of fire from one floor to another and is in line with national standards pertaining to safety from fire.—G.R.

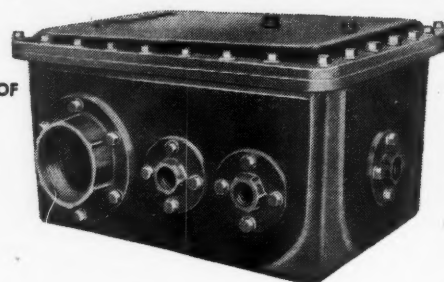
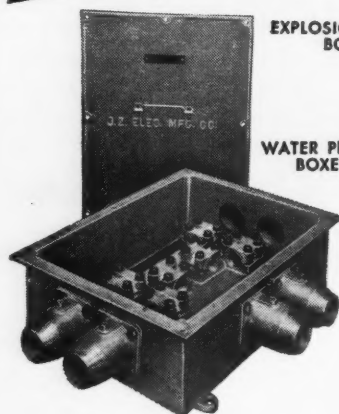
## OVERCURRENT PROTECTION

**Q.** I recently inspected a new garage building and found a set of feeders consisting of three No. 6 type T conductors supplied from a 100 ampere service that extended about 50 feet to a distribution panel. I told the contractor that he would have to provide overcurrent protection for these feeders at their source of supply, and he claims that such protection is unnecessary as all circuits leaving the distribution panel are properly protected. Will you please furnish an answer for this argument?—S.H.

**A.** Your interpretation of the Code is correct. Under Section 2434 you will note that the Code requires overcurrent protection for the conductors to be protected at their source of supply unless the conductors are less than 25 feet in length, are not subject to mechanical injury, have a current carrying capacity of at least one-third that of the conductor from which they are supplied and the feeder terminate in a single set of fuses or circuit breakers. In as much as the feeders in question are over 25 feet in length, they cannot comply with the exception permitted and will have to be provided with overcurrent protection at the service location.—G.R.



C. H. Goddard receives Certificate of Appreciation for serving two terms as Vice President of the East Central Region, Illuminating Engineering Society, from Arthur A. Brainerd, current Regional Vice President. The certificate was awarded at the East Central Regional Conference, held in Philadelphia.



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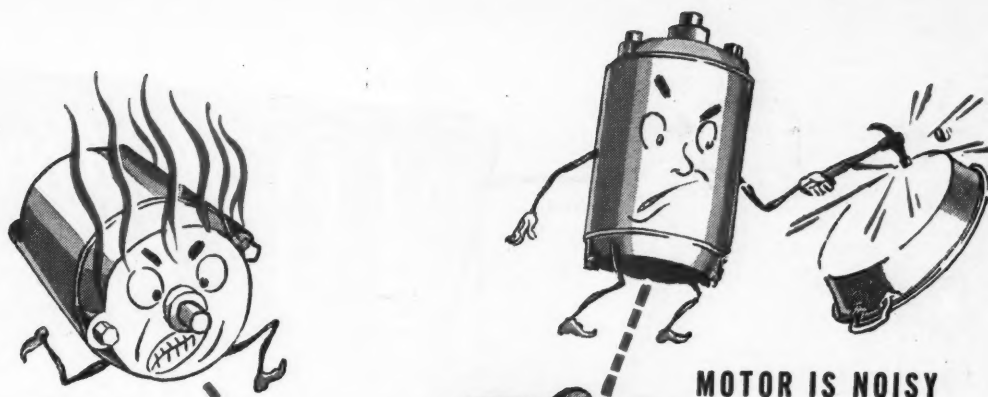
### O. Z. Electrical Products

- Cast Iron Boxes
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- Conduit Fittings
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- Grounding Devices
- Power Connectors

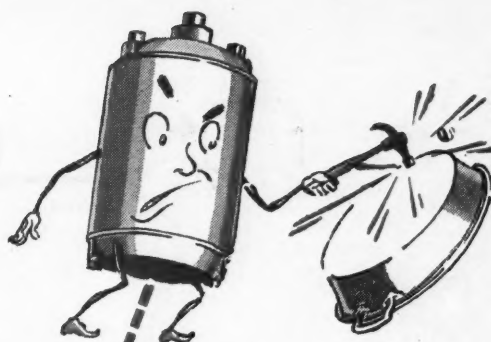
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**O. Z. ELECTRICAL MFG. CO.**  
262 BOND STREET • BROOKLYN, 2 N. Y.

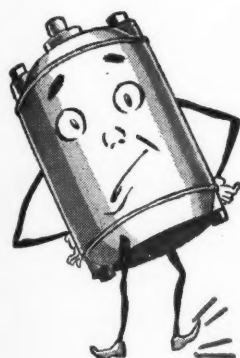
REPRESENTATIVES IN PRINCIPAL CITIES



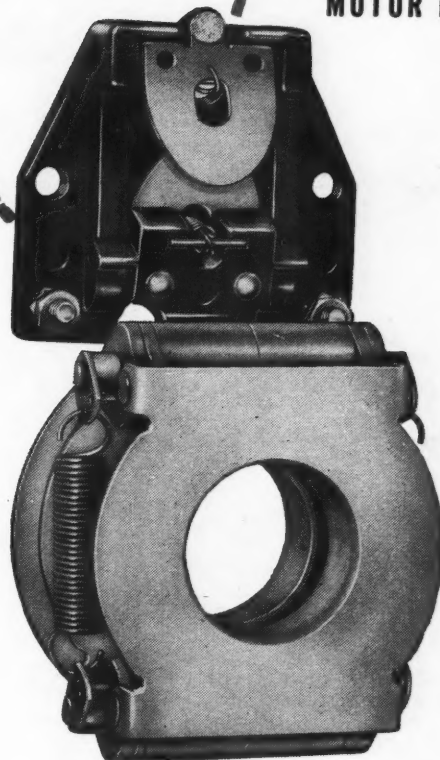
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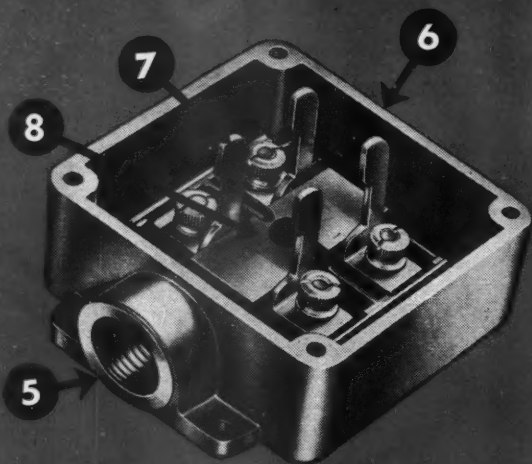
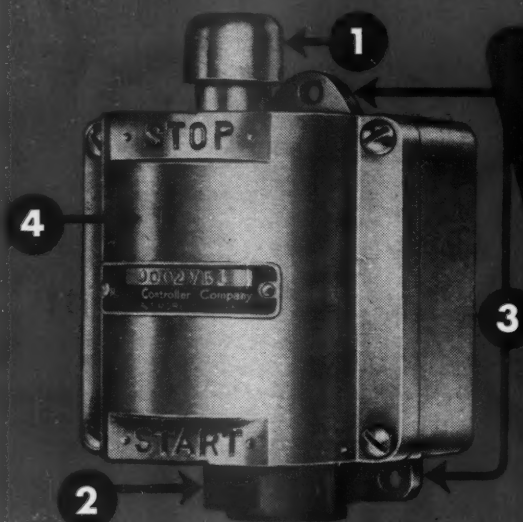
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# ELECTRONICS

## SERVO AMPLIFIERS

By G. O. Smith

The audio amplifier is well known and understood. The servo amplifier is less known and less understood, but probably because of the fact that it is not as universally used. No simpler means is known to bring a weak signal up to a listenable level than the audio amplifier. Hence its universal use in radio receiving sets and sound systems. The servo amplifier, on the other hand, is less universal because of its rather specialized use.

The conditions where a heavy machine must be made to follow a light torque can be solved in several ways. If positioning is not critical, the operator can use a simple on-off controller, and with practice, do an excellent job of causing the machine to stop at the desired spot. A concrete example of this is seen in the manual elevator, run by an operator of long experience. A beginner overshoots and then oscillates above and below the floor whereas an experienced operator shuts off the power at the right instant on the way; the elevator coasts to a stop at the proper position.

In handling a heavy crane, the same may be accomplished. The dexterity of the operator is an important factor, but with practice, this becomes quite high.

On the other hand, a mechanical device such as the controls on a large aircraft require precision positioning. The 'cut and try' method becomes a suicidal method, and yet in a large aircraft the force required to set the control surfaces may be so great as to put a terrific strain on the pilot if no force-amplification is used.

With the use of synchro components, position-data may be transmitted over great lengths on electrical wiring. Once this data has been received, it must be used. The simple synchro system using a synchro motor and a synchro generator to transmit position data or torque is not efficient if the torque exceeds a very minute value. The overall torque on

such a system approaches zero as the position-error approaches zero. The curve of torque versus degrees of deviation between synchro generator and synchro motor approximates a sine curve. With the curve of any system, and the operating torque known, the amount of error can be measured on such a curve. This will never be zero, since zero torque follows only zero deviation and the synchro motor has its inherent friction which must be overcome.

Basically, replacing the synchro motor with a synchro control transformer and driving a servo amplifier with the output will result in almost zero error.

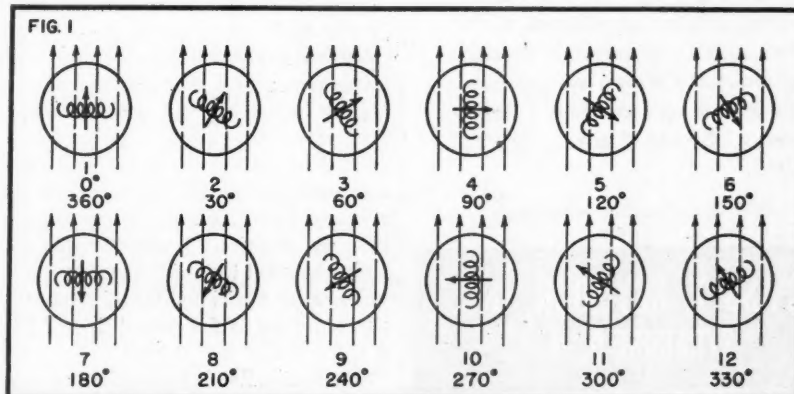
To review the synchro components briefly, the synchro generator develops a set of voltage data in the stator coils which is in proportion to the alternating current magnetic field set up by the position of the rotor. The stator data is transmitted across a three-wire line to the control transformer, which by design, reproduces this magnetic field exactly. Though three stator coils are used, the resulting magnetic field may be resolved into a simple unidirectional magnetic field. Though an alternating current magnetic field can not be identified with the magnetic "north-seeking" or "south-

seeking" poles, the alternation of poles may be "in-phase" or "out-of-phase" with the driving field, in which case the magnetic poles of each, at any given instant, are correspondingly identical.

Figure 1 shows the field diagram of a control transformer with the rotor in several positions. The voltage developed across the rotor for each of these positions is shown in Figure 2. This is a graph of the 60 cycle line current used to energize the synchro components. It must be remembered that as the rotor in the synchro generator is turned, the direction of the magnetic field turns correspondingly. Therefore the position of zero voltage will correspond to the position of the rotor in the synchro generator.

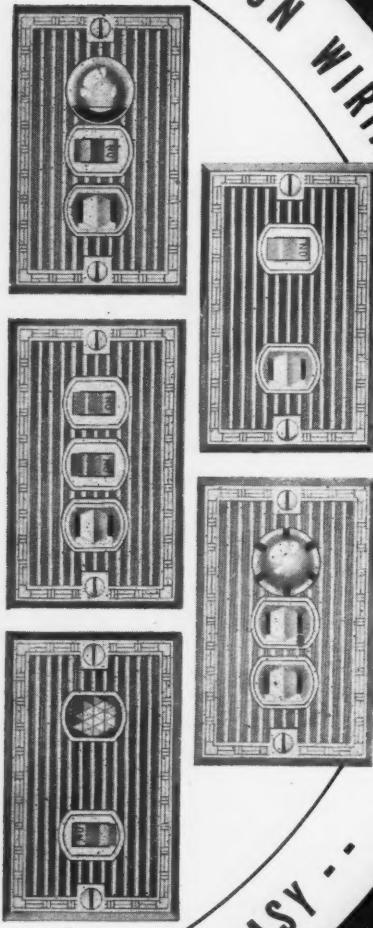
In the complete graph of operation, the control transformer output would be a double-sinusoidal surface, since the instantaneous voltage at any position of the rotor is a function of the sine of the angle between the rotor and the energizing magnetic field, as well as a sine wave voltage for the energizing line voltage.

It will be noted that in Figure 2, positions 1 and 7 both develop zero voltage. This ambiguity is eliminated in the servo amplifier itself, and will be explained later. The solid curves are rotor voltages which are in-phase with the energiz-





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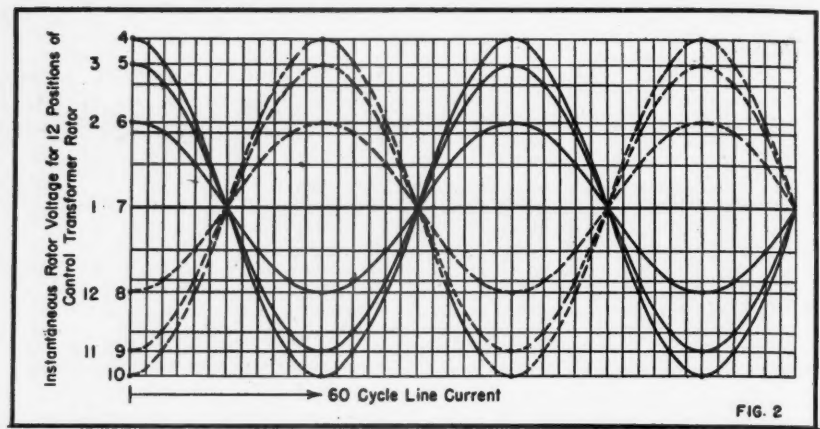


FIG. 2

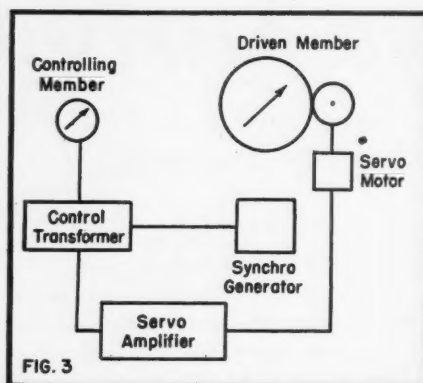


FIG. 3

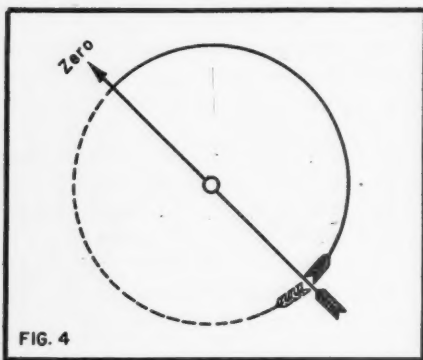


FIG. 4

ing voltage. The dashed curves are rotor voltages out of phase with the energizing voltage.

The servo amplifier takes these voltages, amplifies them, and discriminates against phase. The result is an output energy to the motor which will drive the motor in whichever direction is necessary to cause the magnetic field to line up with the control transformer rotor.

Such a simple servo system is shown in Figure 3. An error voltage resulting from misalignment between the control transformer and the synchro generator results in driving the servo motor from the servo amplifier. This motor is geared to correct the error, and the system operates as in Figure 4, in which voltages from the section (in Figure 1) between positions 1 and 7 apply torque as in the solid line of Figure 4; the rotor voltage for positions 7 to 12 apply torque as according to the dotted line of Figure 4.

Theoretically, it is possible to make a

system balance on the 180° position. In practice this is like balancing a heavy mass on the point of a pin. Line current surges, minor irregularities in alignment, and even the random noise caused by the electron flow in the servo amplifier tubes will cause a minute shift in the electrical zero. Once shifted from position 7, the 180° ambiguity, real torque is applied in the right direction, this torque increases to maximum at 90° or 270° and then falls to zero as the system zeroes properly. Minute fluctuations at the true zero position do not affect the overall accuracy since the system, in effect, is in an electrical detent stop; operating somewhat analogous to a heart-shaped cam in which the cam is maintained in alignment with the camrod by pressure on the latter.

The selection of which direction to turn the motor is known as "phase-sensitivity."

From the control transformer, the signal voltage enters a balanced-output transformer which steps the voltage up and applies equal voltages across two grids of a push-pull amplifier stage as shown in Figure 5.

The plate supply voltage, however, is not direct current but alternating current and in this factor the servo amplifier and the audio amplifier part company. Otherwise they are similar, and in many cases, the servo amplifier is made to work on direct current. Design of servo amplifiers is a wide subject in itself, and no attempt will be made here to do other than to give an outline of the very elementary principles.

The alternating current plate supply, if replaced with the usual direct current supply would make, of this amplifier stage, a conventional audio amplifier.

Since the plate current for each tube passes through the output transformer in opposite directions, no secondary voltage will occur so long as each tube is passing the same amount of current. The equal opposing current surges as the alternating plate supply passes through its positive cycle.

It will be noted, however, that both plates are in phase with one another and

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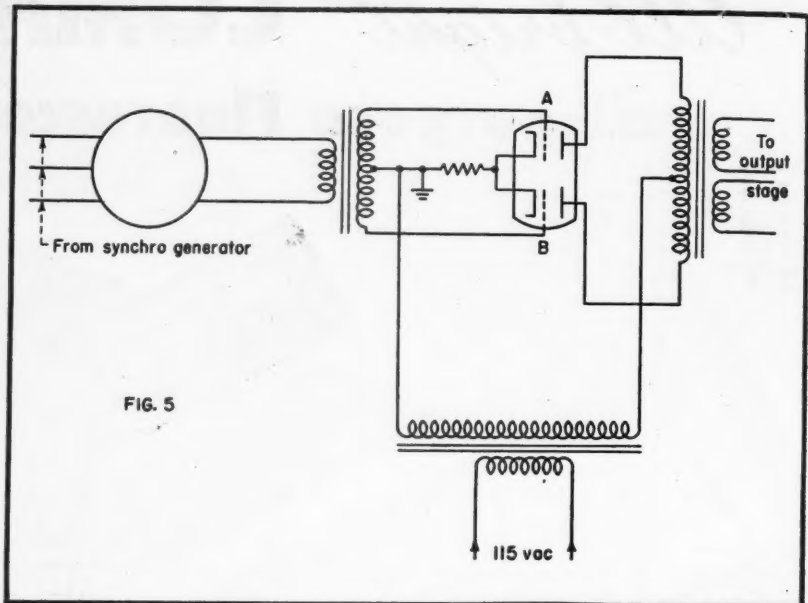


FIG. 5

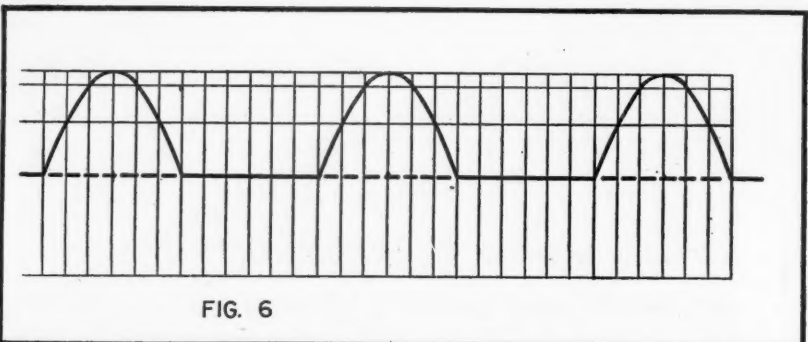


FIG. 6

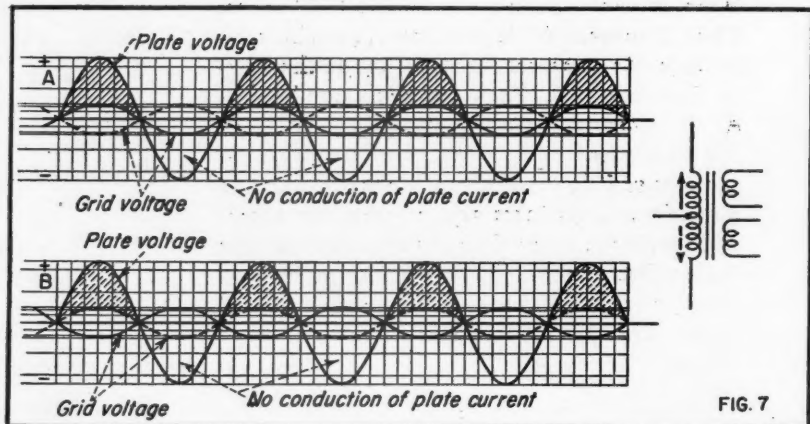


FIG. 7

in phase with the 115 volt a-c supply line. Conduction through such a tube will cause "self-rectification" of the current, and the plate current through both tubes will be as shown in Figure 6.

The plate current through a normal amplifier tube will occur only when the plate is positive with respect to the cathode. And only when plate current is flowing will variations of the grid voltage affect the plate current. We have, then, a situation in this amplifier when a variation of the grid current will have no effect upon the plate current during one half of the cycle.

The grids are fed, however, so that their instantaneous voltage is opposing, as in all push-pull amplifiers. When one

grid is being driven in a negative voltage direction, the other grid is being driven in a positive voltage direction. This, of course, assumes that the control transformer is set at an error angle from the synchro generator in the driven member.

The result is a graph-diagram such as shown in Figure 7. The pulses of plate current are shown for each tube. Superimposed on the plate voltage curves is the voltage that appears from the control transformer. The solid lines show the voltage occurring in the control transformer when it is in position 2 of Figure 2. The dotted curve shows the control transformer output for position 12 of Figure 2.

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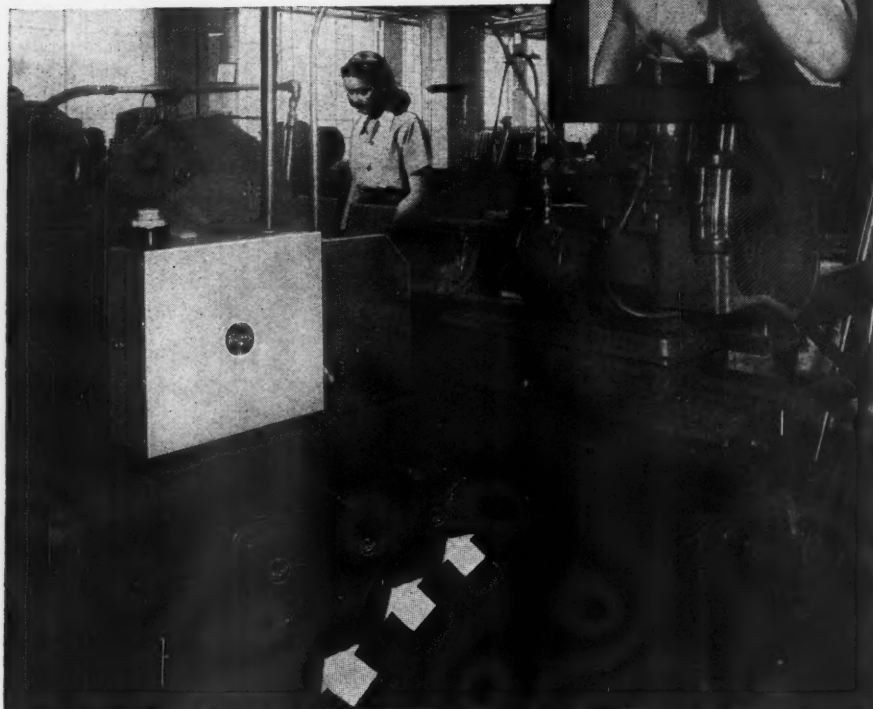
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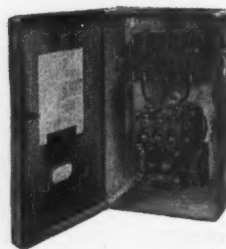
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Taking the solid curve, as in position 2, it will be seen that in Triode A, the grid voltage increases as the plate voltage increases. This results in greater plate current than with zero grid voltage. During the portion of the cycle where the grid voltage is swinging negative, the plate current is also negative and no plate current results.

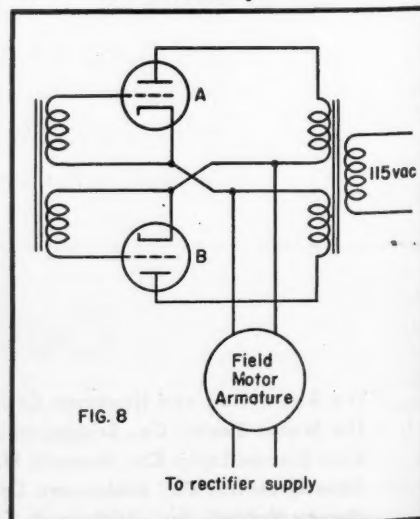
At the same time, Triode B finds the grid voltage swinging negative as the plate voltage swings positive. This results in less plate current than a zero grid voltage would permit, and when the grid voltage is swinging positive, the plate voltage swings negative resulting in zero plate current.

The net result of this is that the plate current of Triode A increases and Triode B decreases whenever the control transformer is turned clockwise from zero.

When the control transformer is turned counter-clockwise from the zero position (approaching position 12) the dotted curves represent the output voltage. The opposite condition then occurs, and Triode B then passes more net plate current than Triode A.

The output plate current, passing through the primary of the transformer, consists of 60 cycle half-wave pulses of current. The direction of these pulses is dictated by the direction of deviation from true zero in the control transformer. The current pulses produce a secondary voltage which is in proportion to the difference in current passed by the two tubes, and also in polarity according to the direction of the heaviest current. The secondary of the transformer is tapped, and drives the grids of an output stage as shown in Figure 8.

These tubes may be high-current thyratrons or medium current tubes such as 6L6's or 2A3's. The effect in this circuit is similar to the phasing effect of the amplifier stage. The phase sensitivity has been accomplished, however, and the lack of direct current supply is only a convenient or economic measure. It is unnecessary.





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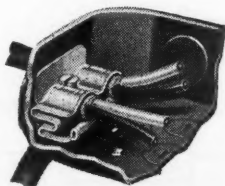
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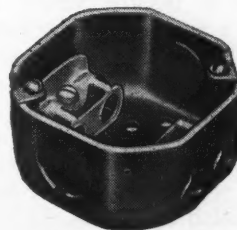
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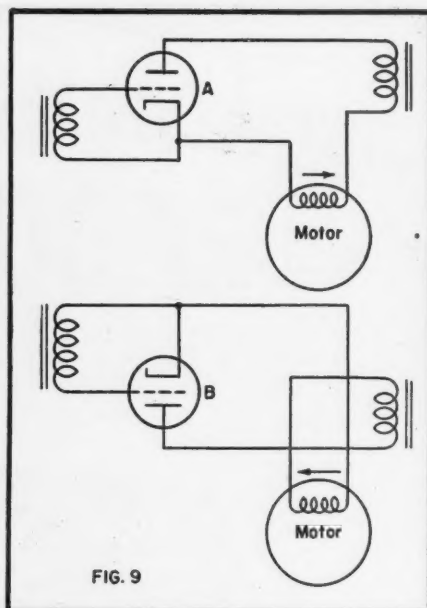


FIG. 9

Breaking down the circuit results in two symmetrical circuits about the transformer and the motor field. These are shown in Figure 9. With a rectifier supply for the armature, passing armature current in one direction only, the direction of motor rotation is dictated by the direction of current flow in the motor field.

The grids of the output stage are returned to their own cathodes since it is the voltage developed between grid and cathode that dictates the flow of current through the tube. And since one grid is driven positive when the other grid is driven negative, their respective voltages control direction of the motor.

The ultimate result of error angle, caused by turning the control transformer away from zero is that the servo amplifier furnishes current to the motor that drives the entire mechanism. The direction of drive is made by design in such a manner as to turn the synchro generator in the driven member so that the latter turns into agreement with the control transformer.

The sequence is complicated, a sort

of "House-that-Jack-Built" affair. You turn the control transformer, producing an error voltage that energizes the servo amplifier, driving the motor which revolves the entire mechanism so that the synchro generator furnishes a magnetic field for the control transformer that results in zero error.

It is often desirable to control a heavy mechanism from considerable distance, in which case it is quite simple to install the synchro generator at the controlling position as in Figure 10. A number of synchro generators may be hooked in parallel to accomplish the positioning from several places.

The split-phase winding is supplied direct from the line, as usual, through the capacitor which causes a 90° phase shift of the current through the winding. This phase is also 90° ahead of or behind the phase of the servo output.

When one side of the servo amplifier is conducting, it passes current in one direction once every cycle of the line current frequency. Changing sides of the servo amplifier conduction is exactly the same as swapping the leads to the full-phase winding. The motor then runs in the opposite direction.

Refinements are usually added to the servo in actual design. Unlike the regular audio amplifier, the servo is required to operate on a single frequency. This permits a higher efficiency throughout. Also, inverse feedback as high as 35 percent is often used to eliminate harmonic distortions which might cause "hunting" of the drive motor.

Inverse feedback operates on a percentage basis unless the feedback loop is tuned. The elimination of harmonics is caused by the fact that these unwanted harmonics are generated within the amplifier system itself. The input voltage which is "pure" is not diminished as much by subtraction due to the inverse feedback as the harmonics, which do not appear, and are introduced as an amplified bucking voltage which cancels out a large percentage of the harmonic content.

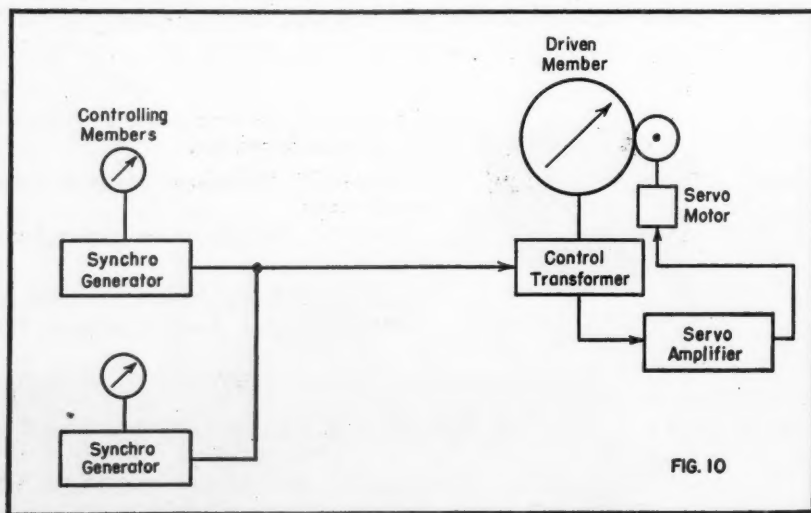


FIG. 10



FEEDRAIL used for cutting machine and moving cloth laying machine with inspection light.

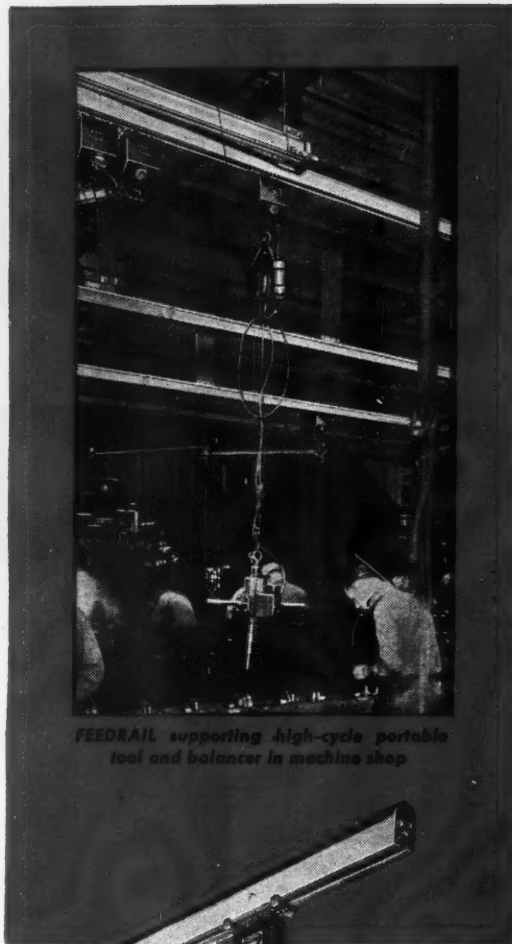
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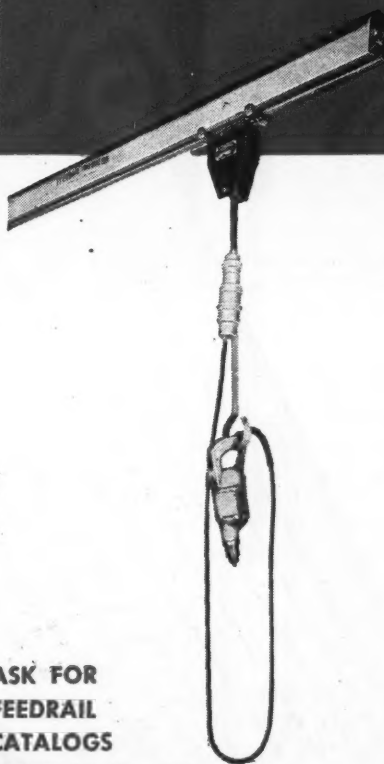
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# IN THE NEWS

## BUILDING CURBS RESTORED

Wartime controls over new building construction, repairs and alterations—designed to channel limited materials supplies into the National Housing Program—were restored late in March by the Civilian Production Administration. The new order (Veterans' Housing Program Order No. 1) contains many similarities to the wartime order L-41.

Probably the principal concern to electrical contractors is the inclusion of electrical equipment under the order's definition of "fixtures", the installation or relocation of which is governed by the general provisions of the order the same as new construction.

Thus, installation or relocation of electrical equipment is prohibited after March 26, 1946, unless it (1) comes within one of the specific exemptions from the order's prohibition of new construction or (2) is on a job approved under the regulations. Specific exemptions include jobs costing less than \$400 on buildings designed for occupancy by five or less families, \$1000 for buildings designed for occupancy by more than five families, commercial buildings, farms, and institutions, and \$15,000 for industrial buildings. Also, jobs on which any materials actually had been installed as of the cutoff date are not halted by the order.

Maintenance work generally is not affected by the order except for the prohibition against incorporating any improvements into the job. Repairing of mechanical devices such as refrigerators, elevators, etc., also is expressly permitted without prior authority so long as the repair work does not involve alteration of a building.

As with wartime orders, prohibitions in the new building order apply equally to seller and user, which means that electrical contractors installing equipment as part of a job will want to assure themselves that the prime contractor has authority to perform the work before delivering or installing materials on the job.

The new program is intended to be administered, for the most part, locally through CPA field offices being re-established throughout the country. At least one such office will be set up in every state and applications for author-

ity to proceed with jobs needing government approval are to be filed with these offices.

Background on the new order prepared by the McGraw-Hill Economics Staff reviews the probable effects.

1) Industrial construction will be cut from the previously forecast level of \$1,100,000,000 for 1946 to about \$825,000,000, a 25 percent cut. This will mean that only the most essential expansions will be permitted—a firm will have to show that an expansion is necessary to remove a bottleneck affecting other industries or essential consumer goods. This will reduce the market for machinery and equipment from an estimated \$2½ billion to \$1.7 billion. Even so, industrial construction, and the equipment market, will be almost 30 percent above 1945.

2) Commercial construction will be cut from \$775,000,000 for 1946 to something like \$600,000,000, a 23 percent reduction. This will, of course, reduce the demand for the types of equipment used in office buildings, stores, restaurants, hotels, theaters, and other types of commercial establishments. That the curtailment of commercial construction will create strains in the economy is shown by figures of the Federal Works Agency which indicate that during the war we built less than one-third of the commercial facilities which would normally accompany the housing we built during the war. A further limitation of commercial construction during 1946 and 1947 will result in an additional increase in the backlog (incidentally, the shortage of commercial facilities is perhaps more serious than shortage of housing in relative terms because we built more than as many homes as the increase in the number of families during the war whereas construction of commercial facilities to serve the new homes was severely restricted during the war. (However, from the standpoint of social policy, it is less harmful for people to stand in line waiting for a place at a grocery counter, a seat at a restaurant, a seat at a theater than it is for people to sleep in parks or in sub-standard dwellings). This means that, although the Wyatt program will reduce commercial construction during the next two years (when everything will be in short supply), it will increase the backlog substantially. And, in spite of the limitations, commercial construction in 1946

will run to about 3 times the 1945 volume.

3) The limitation on industrial and commercial construction is likely to be more severe than the above figures indicate since the estimates are based on the 1946 totals. Because the order permits the completion of construction already underway, industrial and commercial building will be relatively high during the first half. After that, the decline will be sharp—perhaps only 50 percent of the volume of industrial and commercial construction previously contemplated for the last half of 1946 will be allowed to proceed.

4) The limitation order will probably have little, if any, effect on other types of new construction. This is largely because little would be gained by curtailment of highway construction, utility construction, and the like which do not compete with housing for critical materials. Thus, the \$1.8 billion of public construction, the \$650 million of utility construction, and the \$375 million of other non-residential construction (schools, hospitals, churches, etc.) will go forward as previously planned.

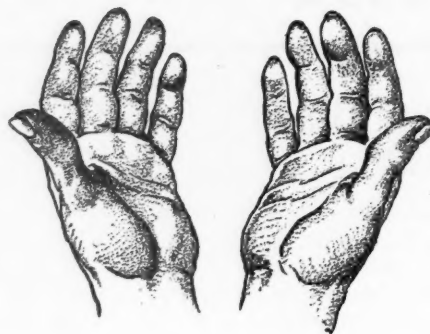
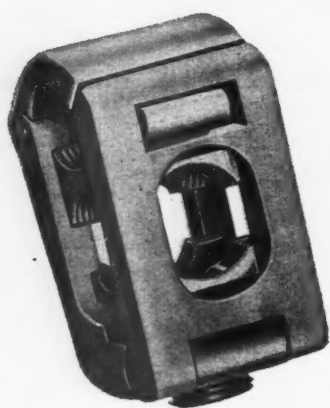
5) The order may impose some restrictions on repair and alteration of existing structures. Obviously, one of the best ways to secure the materials and manpower needed for new housing would be to curtail nonessential repair and modernization of existing homes—all of the materials released could be shifted to new home building whereas a good portion of the materials released by the limitation of industrial construction cannot be used in housing. But such controls would be extremely difficult to enforce.

The Wyatt program will result in a slight reduction in the total amount of electrical work embodied in new construction. Estimates of the Federal Works Agency indicate the expenditures will decline from \$214 million under the pre-Wyatt new construction program to about \$208 million. Here is how the estimates break down by type of construction (expenditures for industrial work include power wiring):

Estimated Expenditures for Electric Wiring and Fixtures		
Pre-Wyatt		
	Construction Program	Wyatt-Program
Industrial	\$71,500,000	\$53,500,000
Commercial	45,750,000	35,200,000
Residential	37,450,000	60,000,000
Other	59,450,000	59,450,000
Total	\$214,400,000	\$208,150,000

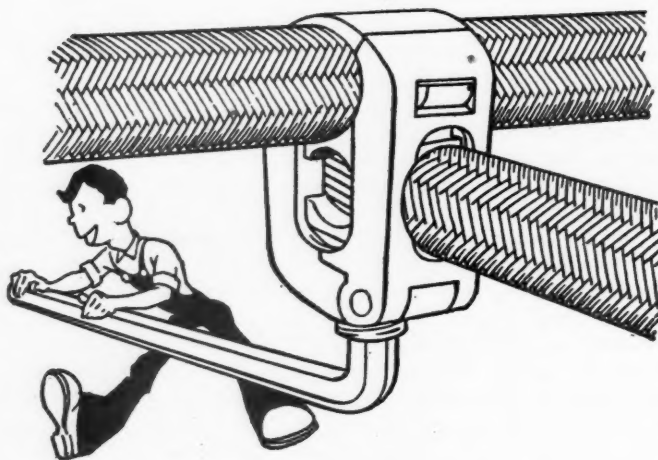
As the table shows, increased residen-





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tial work will largely offset the reduction in commercial and industrial work resulting from the limitation order.

On the other hand, expenditures for plumbing and heating will increase as a result of the Wyatt program. Expenditures for plumbing and drainage in new construction, which had been estimated at \$340,000,000 for this year, will rise to about \$430,000,000 because of the large increase in residential work. Heating and ventilating, formerly slated to cost \$275,000,000, will now total some \$290,000,000.

The electric utility industry will benefit from the Wyatt program in that attainment of the 2,700,000 home goal would increase the number of residential customers by roughly 10 percent. Moreover, residential revenues will show an even greater increase because the homes will probably be, on the average, better electrified than existing dwellings. Industrial and commercial sales will be affected by the limitations on industrial and commercial construction but the boost in residential sales will greatly outweigh this. There is no way to forecast the effects of the Wyatt program on generating and distribution capacity; that will depend on where the homes are located. In general, it probably can be said that the great majority of the homes will be built on vacant lots where utility service is already available—this does not mean, of course, that no additional facilities will be needed but it will reduce the need for new facilities. (It has been estimated that there are 20,000,000 vacant lots in urban areas.)

By the same token, the demand for electric appliances will be boosted by the Wyatt program—there will be 2,700,000 or so customers most of whom will have to have a stove, a refrigerator, a sink, a heating unit and many of whom will want other appliances. This may or may not be a desirable thing from the point of view of the industry, however. The backlog of demand for most appliances is probably big enough, without an accelerated housing program, to keep the industry going at capacity for two years or more; in other words, the Wyatt program will intensify the shortage. A smaller housing program might permit a more orderly, and perhaps more intensive, development of the market.

#### Prefabricated Housing

Perhaps the most dramatic feature in the Wyatt program is the proposal to build 250,000 permanent prefabricated homes and homes assembled on the site from prefabricated parts and materials this year and 600,000 next year. In short, over half of the permanent homes in the program are to be prefabricated units of some sort.

In many ways the situation is com-

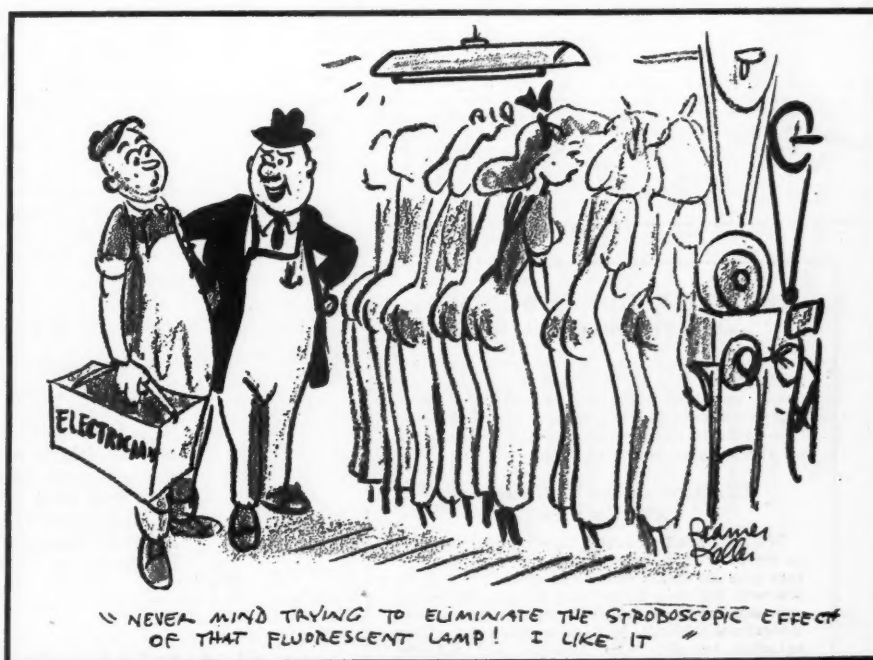
parable to that which confronted the aircraft industry early in the war. Then an industry where 10 planes was a huge order was asked to jump into mass production overnight and a goal of 50,000 planes a year was set. Now Mr. Wyatt is calling for a similar revolution in housing—his goal of 850,000 units in two years compares with wartime production of only 116,390 prefabricated houses for FPHA. To meet the goal an entire industry must be built—production lines must be set up and kinks ironed out; designs must be tested and reworked; new methods must be developed and applied; a system of distribution (something the plane manufacturers didn't have to worry about) must be devised and set in motion. It's a difficult, risky, time-consuming, and even heart-breaking problem.

It is perhaps pertinent to point out, first, that we didn't meet the wartime plane production goal on schedule—production lagged about a year behind, and, second, that the problems facing the prefabricators are in many ways more difficult than those the plane manufacturers faced. We didn't worry about costs during the war but the prefabricators must buy and sell in a competitive market—and that's a big difference. Moreover, the prefabricators face a lot of high hurdles in the form of restrictive building codes and union rules, to say nothing of a certain amount of consumer resistance.

The Wyatt target of 750,000 prefabricated homes in two years is way above what can be reasonably expected. A 500,000 unit goal would be considered high by the experts and production of 400,000 units by the end of 1947 would represent a substantial achievement. Ac-

cording to the Prefabricated Home Manufacturers Institute, the industry is now comprised of 70 firms with an annual capacity of 162,000 dwelling units (which could be raised to 200,000 units by second shift operations). But a bigger obstacle than a lack of capacity is a shortage of plywood which seems to be destined to become the basic material in prefabrication—the 1946 Wyatt program would absorb the entire output of suitable plywood and expansion of plywood capacity would run into shortages of machines and lumber. The plywood shortage alone will probably limit the production of prefabs to around 400,000 units by the end of 1947—whether the industry can produce up to the limit set by materials availability will depend on how successful we are in finding solution to the many and varied problems which will confront the industry.

The importance of finding solutions to the problems which will beset the industry cannot be overemphasized. Our primary economic goal is better living; better living means to a large extent better housing; better housing for the great majority of the population means lower costs—or more quality per housing dollar; lower costs can be achieved only through large-scale production; and large-scale production means some form of prefabrication combined with an efficient distributive organization. Estimates show that a 30% increase in the housing purchasing power of the average family income would be needed to provide a market for a million new homes a year. And a million new homes a year is certainly a minimum goal if we are to have full employment and a rising standard of living.

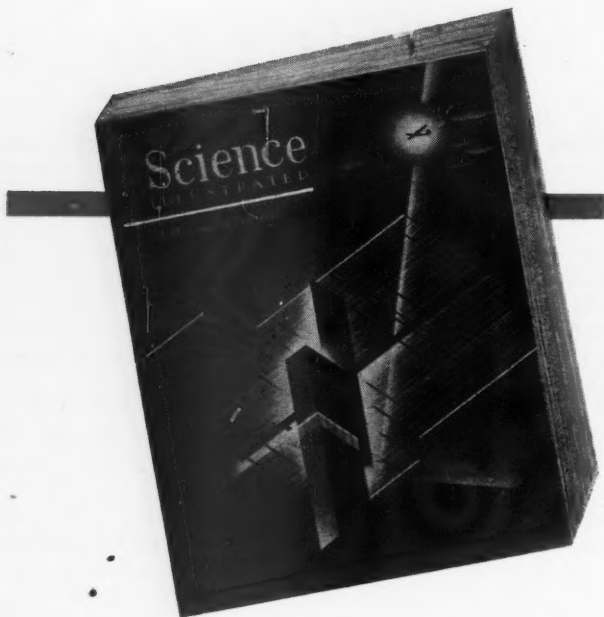




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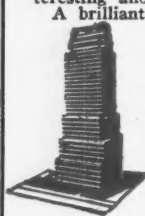
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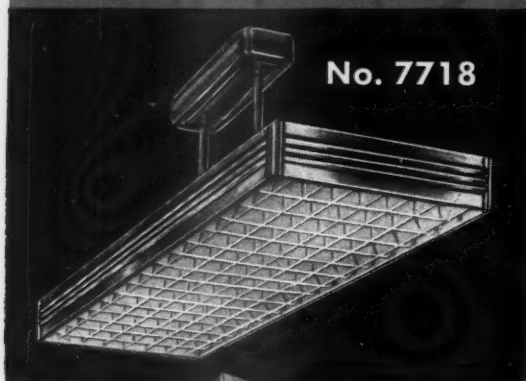
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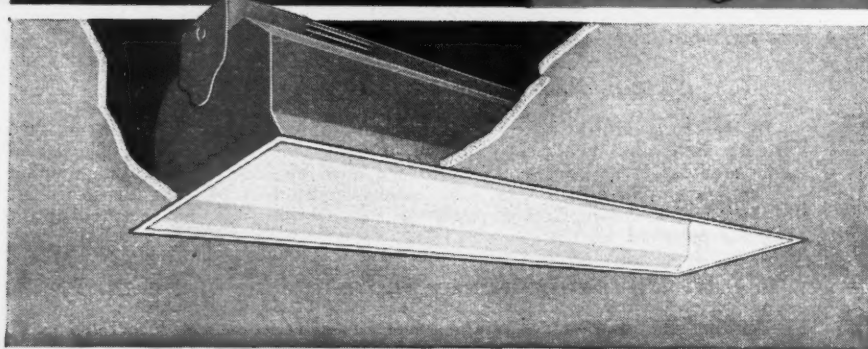


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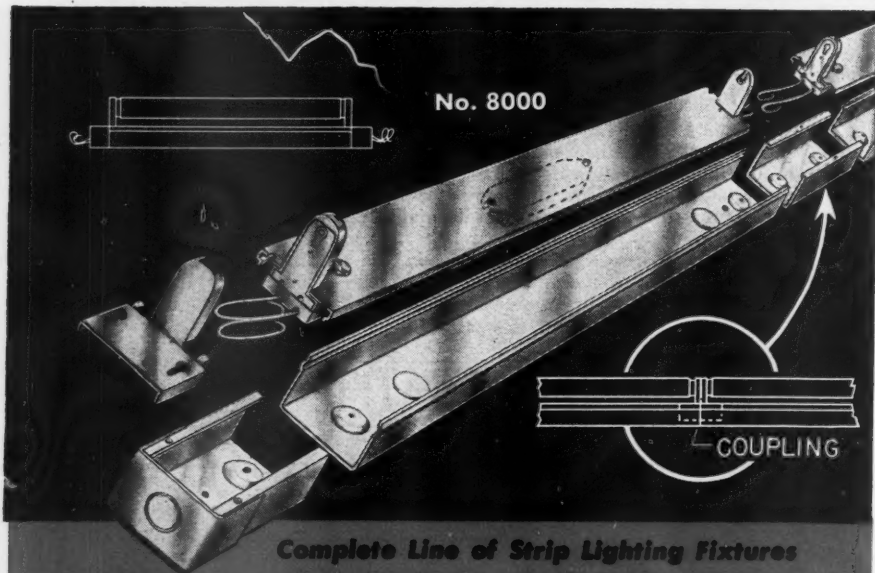
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2) Building codes and trade union restrictions prohibit prefabrication in too many localities. Moreover, even where the restrictions are not prohibitive, they make it impossible to take advantage of mass production economies because standards vary so widely.

3) Many difficult production bugs will have to be worked out before assemblyline production can be achieved. No company has produced houses on anything like the scale needed for economic operation. Some idea of the production problems is given by the fact that an automobile sells for roughly 30 cents a pound while to reach a mass market prefabs will have to be built to sell for something like 15-20 cents a pound.

4) Bridging the gap between manufacturing and final sale to the consumer raises many difficult, and yet to be solved, problems. An efficient distribution system must be erected.

5) In a shortage market for building materials such as we are sure to have for the next two years, it will be difficult for prefabricators to get materials and components because suppliers will tend to take care of old customers first.

6) There is some customer resistance to prefabrication, partly as a result of wartime experience with an inferior product and partly as a result of lack of knowledge. In addition, many builders of conventional houses oppose prefabrication, stating that it will result in a deterioration of quality. Much of this opposition would disappear with large production of high quality units.

According to present estimates, the Wyatt program will involve a total expenditure on new construction of some \$11 billion. The 1946 program breaks down like this:

650,000 conventional homes at an average cost excluding land of \$4,800 adding up to \$3.1 billions;

250,000 prefabricated homes at an average cost (less land) of \$4,200 making a total of a billion dollars;

200,000 temporary re-use war housing units costing about \$1,500 each totalling \$300 million;

50,000 conversions at an average cost of \$500 which adds up to \$25 million;

50,000 trailers at around \$1,500 each or a total of \$75 million. On this basis, the 1,200,000 homes slated to be started in 1946 will run to \$45 billion.

Electrical Contracting, April 1946

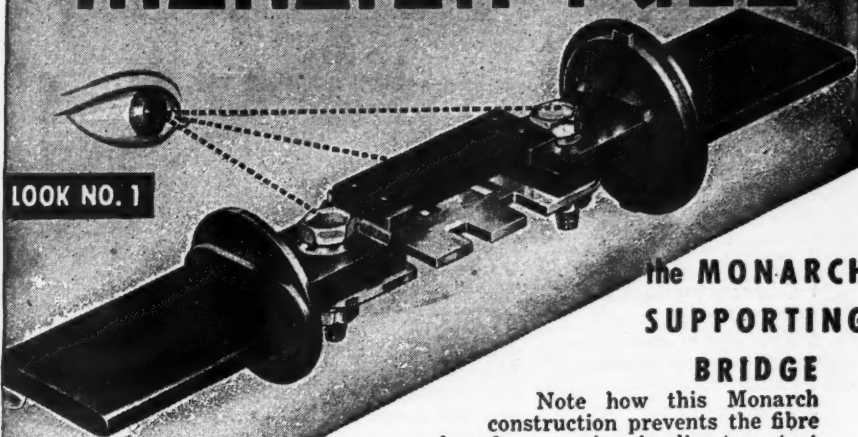
## MINNESOTA HOLDS ALL-INDUSTRY CONCLAVE

After a two year lapse, due to travel restrictions, the Minnesota electrical industry held its annual conference March 11-14 at the Hotel Radisson in Minneapolis. Sponsored by 14 electrical trade groups and coordinated through the North Central Electrical Industries—one of the most closely-knit and cooperative regional electrical activities in the country—the four-day convention and trade show gave some 900 registered industry representatives an opportunity to discuss present issues and look to the future. Estimated attendance at the show was near the two thousand mark. Following the pattern of former years, the conference was divided into individual group meetings and all-industry sessions.

The Minnesota Electrical Council, Inc., has had the best year of its history, reported Wm. A. Ritt, secretary-manager at the Fourteenth Annual Meeting of that group. With a present membership of 360, a roster of 500 is expected within another year. From the standpoint of service to members, Ritt reported that the Council issued more than 600 War Regulations Bulletins during the war years; developed a program for veterans employment (placed 90 of 250 interviewed—the limit present conditions permitted); developed, in cooperation with other groups, a set of credits for veterans service experience in the electrical field; sponsored development of statewide electrical apprentice training program; cooperated in revision of Minnesota Farmstead Wiring Regulations; developed first contractor advertising campaign on fluorescent lighting; developed first statewide appliance advertising campaign; cooperated in development of the Rural Electric Equipment Council; made its largest sale of estimating, bookkeeping and business forms; is now revising the State Directory of Master Electricians. "Today's contractors have the greatest opportunity they ever had . . . they are out of the alley and on main street . . . in on the ground floor of the electrical business and must carry the ball. Salesmanship is the first order of the day," Mr. Ritt concluded.

Unless we, as individuals of the electrical industry, give the public the best we know how, all our engineering and product developments will be meaningless, stated W. T. Stuart, editor, *Electrical Contracting*. Outlining the responsibility of the electrical contractor, Mr. Stuart pictured the contractor—through his individual and group activities—as setting the pace for the entire electrical industry. "This has always

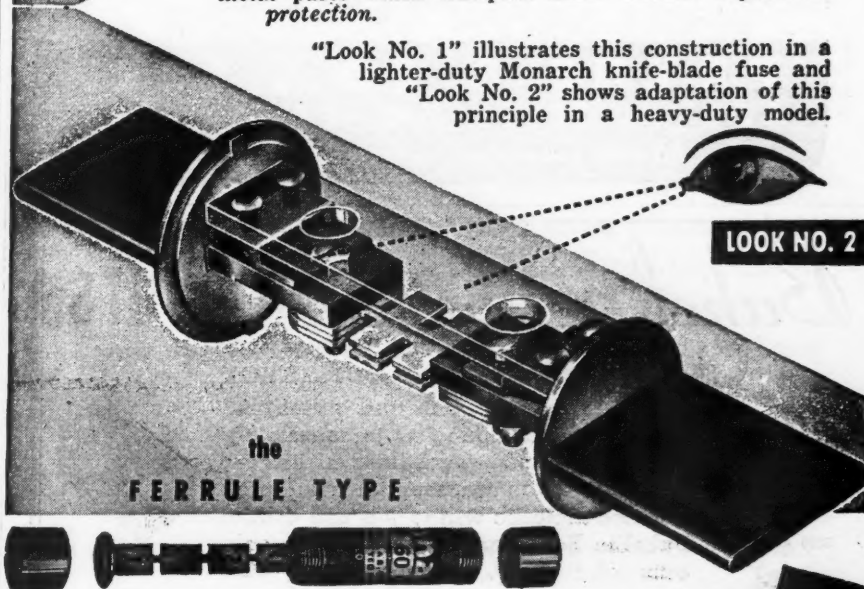
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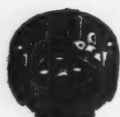
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been true," Stuart added, "but, like interdependence of the electrical industry, has gone largely unrecognized by the industry and—in fact—has not been clearly understood by the contractors." "We are heading into a building era in which a new emphasis will be placed on mechanical trades—especially electrical work—and a vast array of new equipment and devices will be in demand. Through it all the electrical contractor holds the key, for without adequate wiring, competent engineering, skilled application and maintenance, the industry cannot move ahead; with it, nothing can stop us," he concluded.

## Ask Price Relief

Recognizing that the electrical industry and the national economy, in general, is confronted with conditions not conducive to early reconversion activities, the Minnesota Electrical Council went on record, by resolution, "in favor of granting price increases to absorb the added cost of production, due to additional compensation granted labor, and that these increased costs be reflected in the final sale price."

Other resolutions adopted by the Council expressed appreciation for cooperation received to make workable the Council policy on distribution through normal trade channels—manufacturer to wholesaler to contractor-dealer to consumer. Also, an expression of appreciation and pledge of continued cooperation with commercial power companies, municipal utilities and rural electric cooperatives.

## Adopt Training Standards

At the Nineteenth Annual Meeting of the Minnesota Electrical Association (electrical contractors and dealers in Minnesota—outside metropolitan Minneapolis and St. Paul—and neighboring states), the Minnesota State Electrical Wireman and Shopman Apprenticeship Standards were adopted. Formulated by a Joint Apprenticeship Committee representing the Minnesota Electrical Association and the Minnesota State Electrical Workers Council in cooperation with the Minnesota Apprenticeship Council and U. S. Dept. of Labor Apprentice Training Service, these standards call for 8000 hours (four years) of practical experience, each, for electrical wiremen and shopmen, together with at least 144 hours of related classroom instruction per year. Following completion of these requirements, apprentices are subject to a maximum of 500 hours of probationary employment. These standards will form the basis of training under the GI Bill of Rights.

Following adoption of the Standards, a four-man panel on apprentice training reviewed the details of starting a man

in the program and differentiated between on-the-job-training (for salesman, etc.) and training under the apprenticeship standards. Members of the panel were: Baldwin P. Svendsen, field representative, Apprentice Training Division, U. S. Dept. of Labor; F. G. Lubin, vocational division, Minnesota Department of Education; R. A. Turnham, field representative, U. S. Veterans Administration; and Allen N. Sollie, veterans training representative, USES.

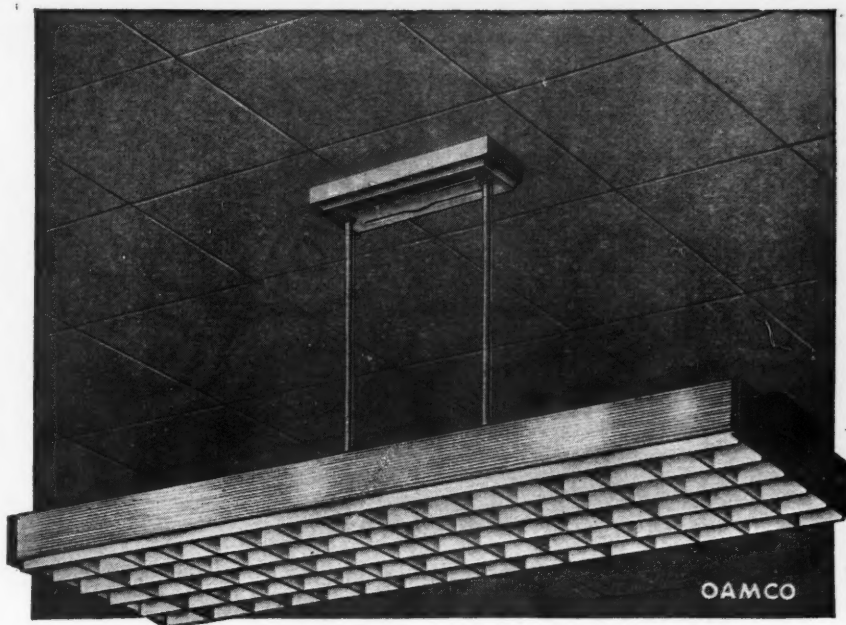
In presenting his report of the Association activities, Wm. A. Ritt, secretary-treasurer, called for a stronger organization to combat restrictive governmental regulations and to advise government administrators of industry problems. Cautioning that appliance dealers must meet postwar competition of chain stores and gas stations, Ritt outlined the need for more association merchandising, advertising and sales programs. The day of the "screw driver and pliers" contractor is past, stated Mr. Ritt, who sees the not-too-distant day when every contractor will need a qualified graduate electrical engineer on his staff. "With our knowledge, experience, skill and know-how—its the competitor who should worry, not us," he concluded.

#### All-Industry Sessions

Supplementing the individual group meetings were all-industry sessions on subjects of common interest. The home freezer of the future will be of 3 to 6 cu. ft. capacity for both urban and farm families—if farmers will utilize locker plant storage facilities, according to A. W. Tressler, General Electric Company. A good market awaits a dual-temperature unit with 8 cu. ft. of refrigeration and 8 to 10 cubic feet of freezer capacity, Tressler believes.

Using a 2,000 family survey as a basis, Frank Brownson, Westinghouse, predicted a trend to first-floor laundries in the home. Of the families interviewed, some 30 percent already had first-floor laundry facilities; 20 percent of those who had none wanted them. Data on automatic washers show a 50 percent increase in number of loads of clothes washed weekly (compared with conventional washing machines); a 50 percent drop in clothes sent to commercial laundries; and a 17 percent decrease in clothes sent to dry cleaners, Mr. Brownson revealed.

George Taubeneck, editor and publisher, *Refrigeration and Air Conditioning News*, believes the established habits of older generation housewives are the biggest obstacle to extended use of frozen foods. That this is being surmounted, however, is evidenced by the fact that chain stores are planning to quadruple their frozen food capacity and packers are planning to market



## Fluorescent Commercial FOR RIGHT WORK LIGHT

The new OAMCO Egg Crate Louver Commercial Fluorescent Fixtures are designed and constructed to give high intensity illumination in stores, offices, drafting rooms and general working areas where maximum light plus fixture beauty are essential. These All-Steel Fluorescent Commercial have a welded steel louver finished in reflector white, side panels of diffusing ribbed glass and satin aluminum finished ends, canopies and stems. The above units are furnished in the four 40-watt size for suspension or ceiling mounting and come completely wired including lamp holders, starters and high power factor ballasts. *Write today for Fluorescent Equipment Catalog #106.*



• See our new line of fluorescent fixtures that will be on display in Booth 68, International Lighting Exposition at the Stevens Hotel, Chicago, April 25 to 30.

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use in gutter of panel box*

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Remember to get Jenkins Gold Seal Tape and you can forget tape that ravels, smears, and dries out. Quality controlled from base cloth to high-adhesion compound. Wrapped in cellophane and boxed so that you get out of it everything we've put into it! . . . Jenkins Bros., Rubber Division, 80 White St., New York 13, N. Y.

**JENKINS** *Gold Seal Tape*  
FRICTION . . . RUBBER

brand-name frozen packaged meat, Taubeneck revealed.

If the electrical industry and the consumer is to benefit at all from the millions of appliances to be sold, the wiring bottleneck must be broken now, warned P. E. McCaughey, manager, National Adequate Wiring Bureau. Thousands of people are being forced to forego an appliance because "there's no place to connect it." Delving into the picture a little deeper, McCaughey estimated that "the missing outlet might have lost 20 times its cost in trade dollars plus the good will of all the people in our industry who would have been involved." Taking a conservative figure of 33 million homes in the U. S. and assuming each is short 10 outlets, McCaughey estimated a possible trade dollar loss of six billion, 660 million times the cost of an outlet. Figure it out. This in addition to the wiring needed to serve these outlets. Continuing from there, McCaughey outlined the NAWB plan book and promotional literature and urged those present to take advantage of this aid to selling adequate wiring to the public in each individual community.

Addressing the all-industry lighting meeting, Willard C. Brown, General Electric Company, reviewed new light sources; predicted a large potential market for the germicidal lamp and better colors, cathode construction and faster starting for the fluorescent lamp. Don Caverly, commercial engineer, Sylvania Electric Products, sees a definite trend away from fixtures in commercial lighting installations. The architectural blending of light calls for coves, soffits and built-in tubes—a natural application for the cold cathode light source, he revealed. Caverly urged utilities and contractors to employ an architect to take advantage of this very definite trend.

Agreeing that the trend in commercial installations is toward the blending of light with architectural design, A. W. Larson, Westinghouse, cautioned that such tailor-made lighting is expensive. Those who lack funds for built-in lighting will still use fixtures, he added. Discussing small office lighting techniques, Larson explained and illustrated non-symmetrical fixture arrangements—U, H, L, and extended-U shapes—installed above and around the private office desk location to provide seeing for the individual.

#### Rural Electric Equipment Council

Much has been accomplished in Minnesota to provide the farmer with the proper type of electrical equipment for his homestead and outbuildings. Credit for this goes to the Rural Electric Equipment Council, organized to diagnose the ills of farm electrification activities and

acquaint the manufacturers with the specific needs of farm electrical applications. Accomplished to date: specific recommendations for size and type of electric welders for farm use; also milk coolers, home freezers, stock tank heaters, hay drying equipment and other items; revision of the Minnesota Farmstead Wiring Regulations. These and other activities were revealed at meeting of the REEC at the conference. Among the suggestions made by a panel of speakers at the session chairmanned by Charles P. Wagner, manager, Farm Service Dept., Northern States Power Company, were: Contractors do an "adequate capacity" selling job on farm "out-building" wiring; eliminate practice of unqualified farm implement and hardware stores wiring and connecting the electrical equipment they sell the farmer; the development of a "traveling electric store or shop" to go around maintaining farm wiring systems; establishment of a re-inspection program to check existing wiring on farms; development of standard rules and requirements of utilities and rural electric cooperatives.

#### Electrical Code Session

The final session of the four-day conference was devoted to a discussion of electrical codes. Glenn Rowell, Minneapolis, reviewed the pertinent changes in the new 1946 National Electrical Code while George Garney of the State Board of Electricity led a discussion of the revised 1946 edition of the Minnesota Farmstead Wiring Regulations which were approved with suggested minor changes.

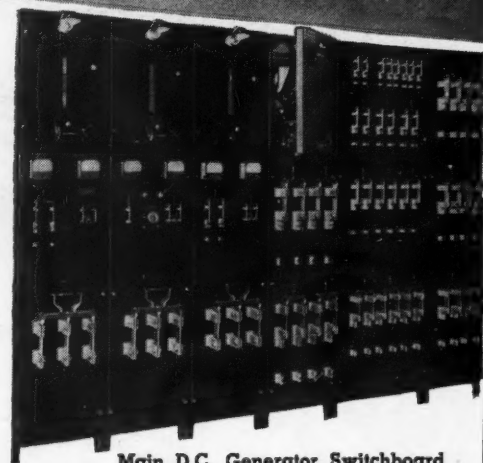
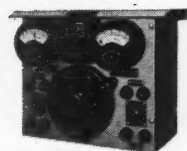
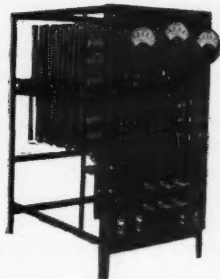
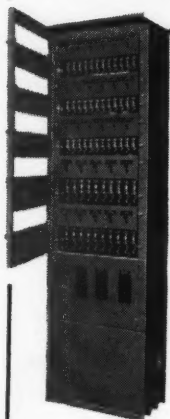
#### Groups Elect Officers

At the business sessions of the various individual electrical trade groups the following officers were elected:

**Minnesota Electrical Council, Inc.**—President, E. G. Nylund, Duluth; vice-president, W. Arthur Starbird, Minneapolis; treasurer, F. M. Tripp, Minneapolis; secretary-manager, Wm. A. Ritt, St. Peter. Directors elected include: (St. Paul) Lawrence Rylander, Don F. Kehne, Wm. F. Lindberg; (Minneapolis) W. A. Starbird, John Morris, F. M. Tripp. Directors-at-large are: A. W. Strohmeier, Minneapolis; A. L. Glatty, Minneapolis; Paul Schorr, Sr., St. Paul; Charles Wood, Fargo, N. D.; Louis H. Gordon, Albert Lea; E. W. Linner, Stillwater. Representing the Council on the North Central Electrical Industries are Wm. A. Ritt, St. Peter; and F. T. Langford, Minneapolis.

**Minnesota Electrical Association**—President, M. A. Oien, Cloquet; vice-president, Moreau Bailey, Albert Lea; secretary-treasurer, Wm. A. Ritt, St. Peter. Members of the Board of Di-

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or  
**SPECIAL**



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**Standardized units** are recommended when they fit your requirements in every detail. Certain types of switchboards and panels enable us to give you the economies of quantity production.

**Special design**, to meet your needs exactly, is provided for major units—or any unusual equipment. The wide experience of our engineering staff will prove most helpful.

Highest quality materials—best of workmanship—and deliveries when promised.

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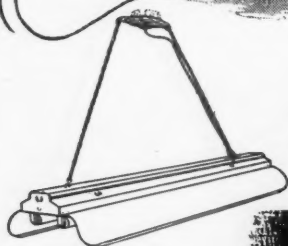
Just connect wires, screw to outlet box and the job's done—in a few minutes. Fits standard 4" or 3 1/4" outlet box or plaster ring. Self-grounding—you can use 2-wire cord and plug. Complete with receptacle, two 5-foot chains, "S" hooks and cord clips. Nothing else to buy.

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Others pending.  
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**DAY-BRITE**  
*Lighting*

## Bend Conduit Cold— Here's How



Conduit can be bent



to any desired angle



without moving pipe



in one operation

*In one single operation  
with Tal's Prestal  
Bender, you can bend  
cold pipe and conduit  
to any desired angle  
without moving the pipe.*

Installation work goes faster, easier, and at a lower cost when you have a Tal's Prestal Bender on the job. This efficient, light, portable machine handles all pipe and conduit up to 3". Makes perfect bends, up to 90°, cold, in one single operation. No need to waste labor by replacing the pipe three to six times to make a bend. Does a good workmanlike job—smooth, uniform bends without kinks or wrinkles.

Simple and easy to operate. Thousands are in successful use everywhere. Write for data bulletin.



**Tal's Prestal Bender, Inc.**  
Dept EC-4 Milwaukee 2, Wisconsin

rectors (3-year term) are: E. W. Liner, Stillwater; Val Zentz, Elmore; Al Kohler, Hibbing; and C. D. Burton, Brainerd (1 year to fill out Bailey's term). Directors to the Minnesota Electrical Council, Inc., are: Sam Newstone, Montevideo (Western Minn.); John Ellenbecker, St. Cloud (Central Minn.); E. G. Nylund, Duluth (N. E. Minn.); Ed Karst, Fergus Falls (N. W. Minn.); and Wm. A. Ritt, St. Peter (Southern Minnesota).

*Minnesota Electrical Inspectors Association*—President, Harold Cooper, Waseca; vice-president, George Garney, St. Paul; secretary-treasurer, Glenn Rowell, Minneapolis.

## NECA, IBEW PLAN NEW APPRENTICE RATIO

The apprentice-journeymen ratios in the electrical construction industry will be adjusted "in line with the needs of their respective areas" by local IBEW unions throughout the county, in accordance with recommendations approved by the National Joint Apprenticeship and Training Committee for the Electrical Construction Industry. This action to lower the apprenticeship bars was taken by this 12-man labor-management committee at the close of a three-day meeting at Milwaukee's Hotel Schroeder, March 10. The purpose was to clear the road for training some 35,000 additional electrical apprentices to meet the demands of the emergency housing program.

At an earlier session, spokesmen for NECA and the IBEW voted support for the plans of the Bureau of Training, U. S. Department of Labor to step up its field operations to meet the national housing program demands for more skilled workers. Addressing the first closed session of the Committee, Maurice M. Hanson, assistant director of the labor dept. bureau and national consultant to the electrical construction industry, asserted that the joint labor-management committees now functioning in the electrical industry should be increased from the present 171 to 485 to speed the proposed housing program. Sufficient federal apprentice training field agents must be assigned to cover the expanded program and such recruits will be culled from the ranks of labor and employers, Hanson revealed. He hopes these additional labor-management committees will be set up in areas now lacking them, not only to facilitate hiring of apprentices but to serve as a "beachhead" for industrial peace during the home building program. It is an accepted fact that relations between labor and management have generally improved in areas where such committees are now functioning.

The major stumbling block in a stepped up apprentice training program is the shortage of building materials, asserted E. J. Brown, international president, IBEW. "You can't train men without materials," cautioned Brown, explaining that he was not opposing an expanded apprentice program but merely citing a factor which might upset it.

E. H. Herzberg, manager, Milwaukee Chapter, NECA, and chairman of the committee, believes that material shortages will raise havoc with the government's program for constructing 2,700,000 living units. Estimates of the committee, based on available and anticipated materials, indicate a maximum of 400,000 units could be built within a year, he revealed.

J. Walter Collins, manager, Electrical Contractors Association of city of Chicago, took exception to the plans for building dwelling units to be sold to veterans. "Veterans are in no better financial position to pay for homes today than they were before they entered service," he said. "We should be talking about building apartments which can be rented around \$50 and not cottages stuck up on the prairie to be sold to the veteran who will find himself unable to meet payments when times become more difficult." Collins questions the equity which GI's—most of them small salaried men—will have in houses they pay \$6,000 for today which, six years from now when "good" houses are again being built will still be labeled "war house."

## RURAL HI-LINE CONTRACTORS UNITE

Convening for the first time as a national group, some 125 independent rural line construction contractors, their material suppliers and bonding agents, met Feb. 18-19 at Chicago's Edgewater Beach Hotel to vigorously protest the policies of REA and the various electric co-operatives.

Final outcome of this "protest meeting" was the organization of a new national electrical group, the Rural Electrical Contractors Association, Inc., whose membership is open to "... all individuals, partnerships, firms or corporations engaged in electrical construction, who have established a reputation for skill, integrity and responsibility. . . ." The avowed purpose of the organization, as outlined in the RECA Constitution and By-Laws is: "To promote better relations between the members . . . and other individuals, firms, corporations and departments of government with whom the members have business relations; to maintain high professional standards in the conduct and performance of work; to combat

FULLMAN

# Latrobe

## PRODUCTS

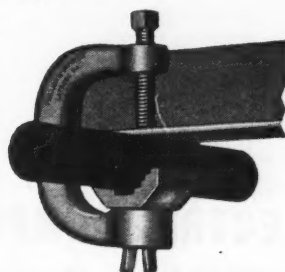
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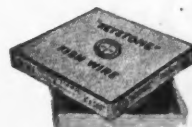
No. 470 "Latrobe"  
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A convenient and perfectly secure for hanging pipe or conduit 1/2", 3/4" and 1" to steel beams up to 3/8" thick.



"Bull Dog" Insulator  
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An ever ready device for fastening porcelain or glass insulators to exposed steel framework.



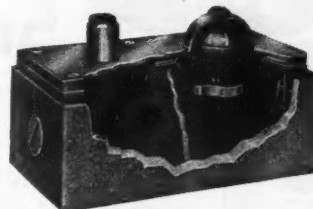
Keystone Fish Wire

This flat wire is of high quality steel properly tempered.



No. 110 "Latrobe"  
Watertight Box

The box body is iron with 3 1/2" round Brass cover plate. No. 208 Receptacle and No. 207 Bull Nozzle.



No. 252-R Floor Box

This Two Gang Box is shown with No. 208 Receptacle in one section. One cover plate with 1/2" Brass Plug, one with 2" Brass Plug.

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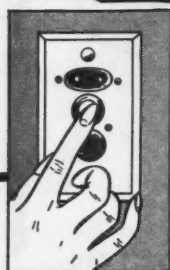
200 William St.

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New York 8, N. Y.

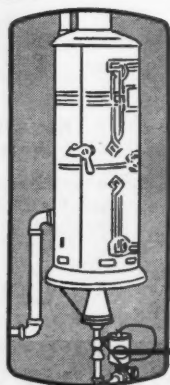
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Requires little or no servicing. A  
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and suppress unfair and discriminate practice by members and those with whom members have a business relationship; to collect and disseminate statistics and information of value to members; to rectify conditions of an unsatisfactory character affecting the business of the members; to encourage methods of contracting and performance which will relieve members of unnecessary and improper risks."

During the course of the meeting, prepared talks and floor discussions were aimed directly at the following REA policies and failings—all highly unpopular with the contractors:

1. Negotiations with low bidders.
2. Discrimination against bidders who also do private utility work.
3. Slowness of payments on monthly estimates and final contract termination.

The existence of the first two policies has prompted the National Electrical Contractors Association to submit in letter form (Jan. 28, 1946) to the Subcommittee on Federal Power, Interstate Commerce Committee at Washington, D. C., a proposed amendment to H. R. 1742 that would outlaw negotiations and discrimination in the awarding of REA contracts.

Morris DeWitt, Porter DeWitt Construction Co., Poplar Bluff, Mo., viewed "negotiation" as a direct threat to the contract system which is based on free open competition. He placed the responsibility for continuance of negotiation squarely on the shoulders of the contractors. No one can make a contractor negotiate, he averred, particularly in the present seller's market. It is unreasonable and against the public interest to expect a contractor to accede to a demand that he lower his price when he has been low bidder in open competition, he added. If prices are seriously out of line, and costs must be analyzed with respect to present market trends, competition will level them out in due course of events by bringing construction costs to the lowest economically feasible point, he concluded. Contractors must hold their "first line of defense" against negotiation, he warned.

Contractors are rapidly becoming underwriters of REA work, declared W. P. Cagney, Jr., Contracting and Material Co., Evanston, Ill., who pointed out that huge sums of money are being tied up in rural lines while co-ops delay in making payments on monthly estimates and final settlements. Such delays, ranging from four months to two years, are forcing contractors to borrow funds to maintain operations. Interest on such loans—a direct job cost—are not covered in the REA contract, he revealed. Cagney charged that certain co-ops were using federal funds earmarked for line construction to purchase other materials, while the unfortunate contractor waited for payment.

*Electrical Contracting, April 1946*

One of our most serious problems will be solved if REA can keep the co-ops from misappropriating line construction funds, Cagney concluded. He also suggested that REA advance funds to the contractor to cover cost of materials delivered to the job, but not installed because of a shortage of specific items necessary to complete an assembled unit (REA contracts call for payment on basis of completed units).

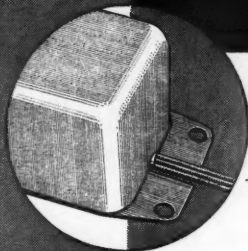
Another thorn in the contractor's side is the REA specification, particularly with reference to line location and clearing of the right of way. Suggesting that co-op engineers give the contractors a set of plans that "definitely locates the hi-line," H. L. Cater, Cater Electrical Construction Co., Kansas City, Mo., made additional recommendations that would tend to lower bids on REA work. Among these were: (1) A "rock clause" that would permit shifting pole location slightly when rocks were encountered; (2) remove "tree trimming" and "clearing of the right of way" out of the wiring contract and pay separately for each tree trimmed or cut down. These are the most difficult items to estimate in line work, Cater declared.

On the subject of "discrimination" A. S. Church, Central Electric Co., Battle Creek, Mich., cited an instance where his company, after being a successful bidder on an REA project in his locality, was disqualified, not because of inability to handle the work, but because they were doing work for a private utility in the area.

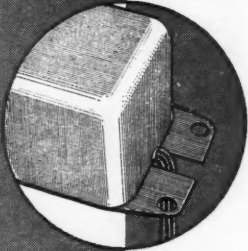
Upon invitation of the contractors to comment on the charges brought up at the session, J. K. O'Shaughnessy, Chief, Design and Construction Division, REA, Washington, D. C., assured the group that steps had been and are being taken to remedy the "failings" outlined. A direct answer to the "negotiation" questions is Engineering Memorandum No. 164 dated Dec. 20, 1945 which definitely states that *REA will not approve any negotiated contracts* unless negotiation was started prior to the date of the memo. This also applies to extensions of existing contracts, O'Shaughnessy added.

Relief for contractors having huge sums of money tied up in "on the job materials" not installed because of a shortage of specific items is provided by Engineering Memorandum No. 165 dated Feb. 15, 1946. This authorizes the contractor to "request an amendment to the construction contract asking for 90 percent payment of materials delivered to the site of the project but not installed," O'Shaughnessy revealed.

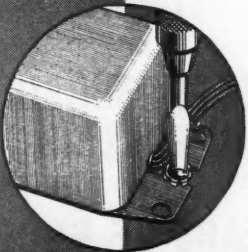
Promise of prompt payment of construction work is included in Engineering Memorandum No. 167, dated Feb. 21, 1946 (contractors' protest meeting held Feb. 18-19). Issued by Mr. O'Shaughnessy, this memo requests all



Where ballast is mounted within the fixture, leads can extend horizontally from other end of case.



For exposed mounting of the unit, deep cut slots allow for downward extension of the leads through mounting surface.



Deeper flange maintains standard clamp hole centers, but provides ample clearance for use of power screw driver.

## the "Double" in a **DRAWN STEEL CASE**

The compactness, rigid strength, and clean-lined appearance of the drawn steel case construction have now been applied by Chicago Transformer to its high power factor fluorescent ballast for use with two 40-watt lamps.

Ease of installation is an outstanding feature of this new design. Deeper flanges, made possible by the more compact case, give mounting holes and slots more clearance, and improved lead exits provide for flexibility in wiring. Mounting dimensions, of course, remain standard.

And, needless to say, this new "Double 40" possesses the same high rating performance characteristics of all Chicago Transformer ballasts.



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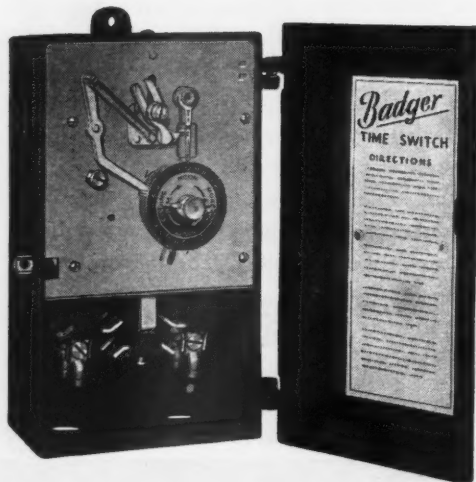
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RELAYS • RESISTORS • RHEOSTATS  
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M1 (Synchronous)
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Switch Capacity
50 A. at 125 V.
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50 A. at 125 V.
50 A. at 125/250 V.

Case
16 Ga. Steel
16 Ga. Steel
Cast Iron
Cast Iron

**RELANCE AUTOMATIC LIGHTING CO.**

**RACINE  
WISCONSIN**

REA system managers and engineers to arrange for prompt payment of the contractor's monthly work estimates, funds for payment to be requested (by managers and engineers) in advance of the completion of that month's estimated work. Requisition for funds and checks are cleared in one week in Washington, he added. O'Shaughnessy stated that co-ops using federal loans for purposes other than that for which they were made are guilty of some misdemeanor.

No clarification of REA's "discrimination" policy was made at the meeting. Declining to elaborate on it, other than to say "there are good reasons for establishing the policy," O'Shaughnessy reiterated the established rule that "Award of a contract shall not be approved if facts indicate that the bidder has an interest conflicting with that of the borrower." Unfortunately this puts all contractors behind the eightball since REA will not—as Mr. O'Shaughnessy put it—"pass upon the integrity" of individual bidders.

With REA connecting about 20,000 additional consumers per month and an estimated 650 million dollars to work with during the fiscal year beginning July 1, 1946, a tremendous program lies ahead. Acknowledging the need of contractor's assistance to build the lines, and the fact that the contractor must make a reasonable profit, O'Shaughnessy called for a closer relationship between the two groups.

Considerable discussion preceded formal organization of the contractor group. Two schools of thought predominated: One to join the National Electrical Contractors Association; the other, to form an independent group. Paul Geary, NECA executive vice-president outlined the NECA organization and presented its proposal to set up a separate section for electrical line construction contractors with, if necessary, a regional rural line construction activity in each of NECA's six geographical regions. A major stumbling block, however, was the fact that a substantial portion of rural line contractors are primarily general contractors and hence not eligible for NECA membership. Many of the contractors present were members of either NECA or the Associated General Contractors of America.

The general consensus of opinion, however, was that the interests of all rural line construction contractors could best be served by a separate organization patterned after the REA regional setup. Thus closer contact with regional REA engineers and co-op managers could be maintained. Hence the formation of RECA with a Board of Directors composed of contractor and REA representatives from each of the 10 REA regions throughout the United States.

RECA officers elected for the current year include: president—W. P. Gagney,

Jr., Contracting & Material Co., Evanston, Ill.; vice-president—R. N. Campsey, R. N. Campsey Construction Co., Denver, Colorado; secretary—P. C. Wallack, Walco Engineering & Construction Co., Tulsa, Okla.; treasurer—S. O. Sorkness, Sorkness Construction Co., Fargo, N. D.

## PR-28 REVISED

The Civilian Production Administration has revised its Priorities Regulation 28 regarding the regulations under which CC ratings are issued.

The revision allows the granting of CC ratings for materials to be incorporated in essential construction, such as a dwelling granted a priority under PR-33. CC ratings also may issue for construction, repair or alteration of a house to be occupied by a World War II veteran when he makes application.

For manufacturers, CPA defined the PR-28 "minimum economic rate" of production up to which manufacturers may expect CPA assistance. It means the rate of operation at which a plant as a whole must produce to avoid incurring financial loss. It pays no heed to any particular product of a plant making more than one item. If plants are operating at less than capacity without financial loss, their minimum economic rate will not be considered to be higher than the current output rate, even though some normal products may not be in production.

Most manufacturers will receive CPA assistance only until they reach their minimum economic rate, but those making commodities which have formally been designated by CPA as being in critically short supply may get assistance beyond minimum economic rates.

Other changes in PR-28 include a statement that CPA will not assign ratings for more than a 60-day supply of production materials and operating supplies although further application may be made later.



Members of nationally prominent electrical contracting firms are (L to R): J. Fischbach, Fischbach & Moore, Inc., New York City; B. D. Robinson, Jr., J. Livingston Co., New York City; and Harry Hauschild, Fischbach & Moore of Dallas, Texas.



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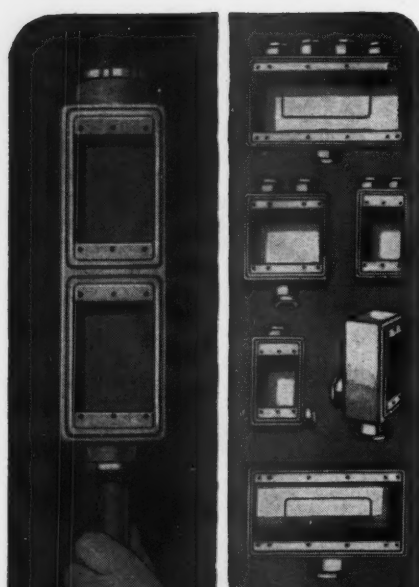
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## PRODUCTION MEETING DRAWS LARGE CROWD

Chicago industry sent some 2300 of its key management and production personnel to the Third Annual Conference of the Chicago Technical Societies Council at the Hotel Stevens March 20-22. The Council—embracing 47 technical societies with a membership of 17,000—sponsored the three-day Chicago Production Show and Conference to afford its members an opportunity to discuss technical problems incident to production in the Chicago metropolitan area. Registrants also filled the huge exhibition hall to capacity, visiting 125 exhibits of more than 100 manufacturers of production machines, parts and accessories.

Patterned closely after three previous War Production Conferences, this one embraced a theme of "Production for Profit" offering 46 different Panel Sessions where registrants could exchange ideas designed to speed Chicago's peacetime industrial activity. With industry facing rising costs of material and labor under consumer price ceilings, all present were anxious to learn of more efficient production methods to meet the current situation.

General subjects covered, and the number of panels devoted to each, were: Electric Power and Electronic Applications (5); Food Processing (2); Foundry Practices and Problems (6); Heating and Air Conditioning (2); Industrial Chemistry (2); Industrial Hygiene (1); Industrial Management (6); Industrial Lighting (1); Instrumentation (4); Materials Testing (1); Plastics, Paper and Rubber (4); Protective Coatings (4); Tool Design (4); Welding and Brazing (4). Each two-hour panel session embodied general floor discussion following prepared talks by experts in the respective subjects.

Among the panels of prime interest to industrial plant electrical men were those on lighting and power and electronic applications. At the IES sponsored panel on lighting, chaired by Carl Zersen, manager, Chicago Lighting Institute, the aspects of planned industrial lighting were reviewed. Carl Jensen, district engineer, Westinghouse Electric Corp., Chicago, cautioned those present against choosing a lighting system primarily on the basis of initial cost. "Too many factors enter into consideration," he added, enumerating such items as type of lighting desired, power costs, lamp replacements, maintenance cost, etc. Final choice of a lighting system should hinge on operating costs, he asserted. To prove his contention, he presented a comprehensive cost analysis of three different lighting systems—incandescent, fluorescent and mercury-vapor—all designed for

the same plant and identical footcandle levels of illumination.

The ease with which an object is seen depends upon size, contrast, time, and brightness, stated Ralph Lusk, lighting engineer, Commonwealth Edison Company, Chicago. Elaborating on each item, Lusk discussed the harmful effects of harsh shadows and excessive brightness that leads to uncomfortable direct and reflected glare—all of which affect the eye-health and operating efficiency of the employee.

Today we have 50 to 100 footcandles of recommended illumination for fine manufacturing, compared with recommended values of 3.5 to 6 footcandles in 1915, asserted Don Ingwersen, lighting engineer, Sola Electric Co., Chicago, as he reviewed the history of illumination level increase over the years. Forecasting further increases in lighting levels, Ingwersen revealed existing experiments where lighting engineers have succeeded in obtaining 5,000 footcandles of artificial indoor illumination at a test installation.

The AIEE panel, chaired by W. M. Ballenger, General Electric Co., Chicago, embraced electrical application and power problems. "Within the next ten years we may see an increase of two or three times the eight or nine million kva. of resistance welding now in use," predicted R. E. Young, power engineer, Public Service Company of Northern Illinois, Kankakee. Young warned prospective purchasers of resistance welding equipment to make a careful economic analysis of all factors involved before ordering such equipment. Citing a case where one \$5,000 unit cost more than \$10,000 before it was installed satisfactorily, he suggested a careful analysis of plant power system and supply before making a decision. Young then outlined methods employed by power companies to prevent excessive lighting flicker when heavy welder loads are encountered on their lines.

With the modern trend toward individual electric drives on production machines, consideration should be given to the flexibility of all-electric, wide speed range drives, asserted H. E. Nason, industrial engineering supervisor, Westinghouse Electric Corp., Chicago. Nason outlined the distinctive features and applications of five types of drives now available—the series variable-voltage drive; the self-excited, shunt adjustable voltage drive; the conventional adjustable voltage (Ward Leonard) drive; the shunt motor with an electronic rectifier; the conventional adjustable voltage drive with a Rototrol regulating generator.

Any discussion of production efficiency is not complete without some reference to the applications of electronic controls and high frequency heat-

ing. "Induction and dielectric heating contributed as much to production during the war as any other tool available," stated Howard Carlson, electronic engineer, Allis-Chalmers Mfg. Co., Milwaukee, who briefly reviewed the elementary theory of induction (60 cycle to 2 megacycle range) and dielectric (10 megacycle to 100 megacycle range) heating processes. T. E. Jontz, application engineer, General Electric Co., Chicago, concluded the panel session with a discussion of the wartime applications and future possibilities of electronic control in industry.

The field of medical science may be the first to utilize peacetime application of atomic energy, asserted Major General Leslie R. Groves, U.S.A., Director of the Manhattan District. Speaking at a luncheon session on the "Engineering Aspects of the Atomic Bomb Project," he revealed that the consensus of engineers and scientists is that, with energetic government support and research, it might be possible within 10 to 15 years to use atomic energy to run power plants in competition with coal if sold at \$15 per ton. "Control of the atomic bomb depends upon world cooperation and understanding—the kind of cooperation that put the U. S. atomic bomb project across," he concluded.

## KRUMM CHAIRMAN OF WISCONSIN INSPECTORS

A. W. Krumm of Manitowoc, Wis., was elected chairman of the Wisconsin Chapter, International Association of Electrical Inspectors at that organization's recent conference in Milwaukee's Wisconsin Hotel. Other officers chosen at the time include: Walter Wilke, Milwaukee, vice chairman; J. E. Wise, Madison, re-elected secretary-treasurer.

Members of the Executive Committee are: A. G. Addler, West Allis; A. B. Middlemas, Milwaukee; George Rothe, Fond du Lac; and P. E. Widsteen, Menasha.

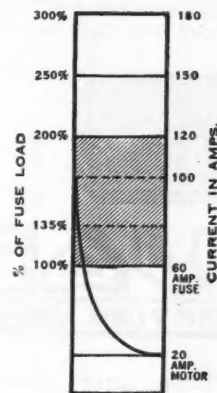


Advice on farm electric motor service is given J. T. Farness (left), Farness Electric, Waterford City, N. D., by C. A. Brandvik, Fargo Electric Motor Company.



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## N. Y. PRIZE FUND TO SPEED HOUSING

Labor and management in the New York electrical construction industry recently announced the setting up of a \$6,000 fund for prizes for suggestions from workers on the job to lower the cost and help speed building of housing.

The winning prize will be \$2,000 in cash in addition to interim prizes ranging from \$350 in victory bonds down to smaller cash awards.

The fund was set up by the New York Electrical Contractors' Association, Inc., and Local 3 of the International Brotherhood of Electrical Workers, each organization contributing \$3,000.

Creation of the prize fund follows a recent decision by Local 3 and 364 contractors to promote the use of high-speed tools, equipment, and methods in an effort to speed housing construction. The unions and employers also exchanged no-strike, no lock-out pledges for the duration of the housing shortage. The union has also voluntarily relinquished its contractual right to time and one-half for overtime and agreed to work two shifts at regular rates.

Employers and the union announced the formation of a coordinating committee for improving installation practices for the electrical contracting industry. Members of this committee, which is composed of workers and employers, will judge the winning awards.

As part of its campaign to develop more efficient techniques, the union has solicited machine manufacturers to develop high-speed pneumatic and electric drills suitable for electrical installation. Union officials complained that existing drilling methods call for unwieldy tools and machinery, retarding operation.

In discussing the formation of the \$6,000 prize fund, Harry Van Arsdale, Jr., business manager of Local 3, said:

"The problem in the electrical construction industry at present is not wages, hours, or conditions, but rather to make labor and management more productive as part of a sound reconversion program."

As part of the effort to popularize the efficiency drive, the union is calling borough-wide meetings of electrical workers, foremen, superintendents, engineers and city officials.

Efrem A. Kahn, president of the New York Electrical Contractors' Association, Inc., said:

"We are determined to make drastic cuts in the cost of electrical construction in New York. Workers in the industry need have no fear that the use of streamlined methods and high-speed tools will reduce employment opportunities. As construction gets under way there is very likely to be a tight labor situation."

## MINN. CONTRACTORS APPEAL TO CONGRESS

Electrical contractors in Minnesota face one of the most critical periods in the history of their business because of electrical material shortage, according to a recent report of the Minnesota Electrical Council, Inc., at Minneapolis. After making a recent survey of the materials situation in the area, the Council sent the following wire to each member of the Minnesota Delegation in the United States Congress:

"Electrical contractors in this area face a complete shutdown in 30 to 60 days due to shortage of electrical materials and equipment. This will demoralize all industries and construction programs including housing. Reports indicate manufacturers exporting large portion of production electrical construction materials and equipment to South America and Europe because of domestic price ceilings and other factors favorable to export trade. Urge immediate investigation and action to correct conditions unfavorable to adequate supply for domestic needs."

Prompt response was reported from practically everyone and investigations were started with the Department of Commerce, Civilian Production Administration, Small Business and O.P.A.

The Minnesota Small Business Commission adopted and sent a resolution to the Washington Congressional Delegation from Minnesota asking for consideration of the testimony of lumbermen, electrical men and others.

The Council hopes these investigations will have some effect and reports that the immediate problem is to secure sufficient materials for the most urgent maintenance, repair and housing needs.

## STATE VERSUS CITY LICENSING IN OKLA.

Holders of state licenses from the electrical administrative board are not required to obtain a city license and post bond with municipal authorities, Randall S. Cobb, Oklahoma state attorney general, has ruled.

Clifford Anderson, secretary of the board, asked for the opinion, citing the provision of the law that the holder of a state license shall be entitled to exercise the privileges thereof in any part of the state and within the jurisdiction of any municipal or other local authority.

Anderson said Tulsa and many other municipalities require examination by local boards and the payment of license fees, and a bond to protect the public against defective work and materials.

An occupation license for electrical contractors is under consideration by Tulsa, Okla., city officials to offset the

\$4,000 annual loss suffered through a legislative act permitting electricians to work anywhere in the state on a permit issued by the state electrical examining board.

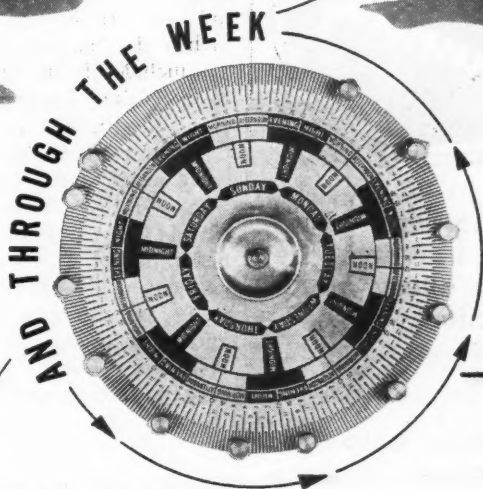
## BOOK REVIEWS

### ONE WORLD OR NONE

For the first time in a single book, "One World or None," the entire story of the atomic bomb is thoroughly discussed by an impressive group of outstanding authorities intimately associated with the development and application of this new source of power, destruction and international mistrust. Listed in the group of contributing editors are five Nobel Prize winners, the General of our Army, ten college professors, leaders in industrial research, a senate advisor and a news analyst. The opinions expressed are the result of mature thought based on known data and, although technically and scientifically factual, are presented in interesting, understandable terms for the non-technical reader. With so many contributing writers, it is surprising that their several interpretations of results and their prophecies of future probabilities show such unanimity of thought. All are agreed that civilization is facing a major crisis; an atomic race is already under way and must be stopped if world peace is to be achieved; the new power is a genie which may be usefully harnessed or devastatingly unleashed by sound or careless statesmanship; there is no defense against this new weapon and international collaboration is vital.

In recounting the history of the bomb the book describes the discovery of the neutron by the British in 1932, the German establishment of a chain reaction in 1939, the American period of development, procurement of materials and personnel, research, building of chain reaction units and plants for producing large quantities of fissionable material, constructing pilot planes and bomb housings, the final experiment in New Mexico and the climatic, terrible application of this power at Hiroshima last summer. The introductory chapter reports an interview with the first official Japanese observer to enter the city after the August sixth bombing and, through his eyes, the reader can vision the single bomb from a single plane wiping out a city of 400,000 inhabitants and totally destroying over four square miles with a Japanese-estimated loss of over 650 million dollars. Bringing the facts to our own doorstep, the equivalent damage resulting from a similar explosion in midtown Manhattan is imagined and analyzed. Some conception of the power is realized through the fact that the fission of a pound of uranium

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or plutonium releases more energy than the exploding of 13,000 tons of TNT and the heat of this transformation exceeds the temperature at the sun's center.

Other chapters discuss the existence of planetary atomic power, explain fission and chain reactions, suggest possible applications for peacetime use and outline possible methods for internationally controlling atomic development and use. The opinions of the editors should serve as guides towards clearer thinking in forming opinions on both questions of internal affairs and foreign policies. A strong appeal is made for international understanding between physical scientists, statesmen, economists, military personnel and the masses of people who elect and follow these leaders.

"One World Or None" is jointly edited by Dexter Masters and Katherine Way. Niels Bohr writes the forward and an introduction is presented by Arthur H. Compton. Contributing editors include H. H. Arnold, Albert Einstein, Walter Lippmann, Gale Young, Hans Bethe, E. U. Condon, Irving Langmuir, Philip Morrison, J. R. Oppenheimer, Louis Ridenour, Frederick Seitz, Harlow Shapley, Leo Szilard, Harold Urey, Eugene P. Wigner and the Federation of American Scientists. The text covers 79 pages, size is 8½ by 11 inches and the price \$1.00. It is a Science Illustrated Book, published by Whittlesey House, McGraw-Hill Book Co., Inc., 330 West 42nd St., New York 18, N. Y.

## REPAIR SHOP DIAGRAMS

Students, motor design, electrical and maintenance engineers, repairmen and armature winders who have need for practical, step-by-step instructions on the laying out of coils for induction motor windings, will find this information in the second edition of Repair Shop Diagrams, recently revised and brought up to date through the second World War. It also gives easily followed instructions through diagrams, tables, and sketches for connecting the ends of groups of coils in proper sequence of phase and pole groups for different types of windings used in motors of from 2 to 24 poles, both 2 and 3-phase. Each diagram is a practical shop drawing, with the ends of all phase groups of coils marked with proper connections, making it easy for the winder to follow the diagram when making connections.

The coil-grouping charts have been extended to cover up to 720 slots, and can be used to select a slot factor that will be common to many poles and phases, lap or wave windings. Dual-

voltage eight- and nine-lead diagrams have been added to the first edition.

The first eight chapters are devoted to "how to do" discussions with examples, explaining how to use the connecting diagrams, coil-grouping charts and tables, and other information presented. The book contains 42 chapters, and 387 pages. It is 6 by 9 inches in size.

Repair Shop Diagrams, second edition, was written by Daniel H. Braymer, late Editorial Director, *Industrial Engineer*, and A. C. Roe, Manufacturing Engineer, Manufacturing and Repair Department, Westinghouse Electric Corporation. It is published by McGraw-Hill Book Company, 330 West 42nd Street, New York 18, New York. Price is \$3.50.

## DATES AHEAD

**National Electrical Manufacturers Association**—Spring Meeting, Palmer House, Chicago, Ill., April 8.

**Rocky Mountain Chapter—IAEI**—Rm. 385, City and County Bldg., Denver, Col., April 9.

**National Industrial Service Association**—National Convention—Tampa, Fla., April 8-10.

**American Society of Tool Engineers**—Fifth Annual Exposition, Public Auditorium, Cleveland, Ohio, April 8-12.

**Southwest District Meeting, A.I.E.E.**—Plaza Hotel, San Antonio, Texas, April 16-18.

**Kansas City Chapter, IES**—One-day lighting conference, President Hotel, Kansas City, Mo., April 19.

**Wisconsin Electrical Association**—Annual Conference, Hotel Loraine, Madison, Wisconsin, April 19-20.

**National Electrical Wholesalers Association**—37th Annual Convention, Stevens Hotel, Chicago, Ill., April 21-25.

**Society of the Plastics Industry**—First National Plastics Exposition, Grand Central Palace, New York, N. Y., April 22-27.

**International Lighting Exposition, NEMA**—Stevens Hotel, Chicago, Ill., April 25-30.

**Chamber of Commerce**—Annual Meeting—Atlantic City, N. J., April 29 to May 1.

**National Modern Homes Exposition**—Metropolitan Association of Real Estate Boards—Grand Central Palace, New York, N. Y., May 4-11.

**Housewares Show—National Exhibition**—Convention Hall, Atlantic City, N. J., May 13-17.

**Rocky Mt. Chap.—IAEI**—City and County Bldg., Denver, Col., May 14.

**National Fire Protection Association**—50th Annual Meeting, Hotel Statler, Boston, Mass., June 3 to 6.

**Rocky Mt. Chap.—IAEI**—City and County Bldg., Denver, Col., June 11.

**National Electrical Manufacturers Association**—The Homestead, Hot Springs, Va., June 17-19.

**American Institute of Technical Engineers**—Summer Convention, Detroit, Mich., June 24 to 28.

**New York State Association of Electrical Contractors and Dealers, Inc.**—Annual convention, Saranac Inn, Saranac, N. Y., July 1-6.

**Rocky Mt. Chap.—IAEI**—City and County Bldg., Denver, Col., July 9.

*Electrical Contracting, April 1946*

**Southern California Construction Industries**  
—Exhibition and Home Show—Pan-Pacific Auditorium, Los Angeles, Cal., July 12-21.

**Pacific Coast Convention—AIEE**—Seattle, Wash., August 26 to 31.

**Rocky Mt. Chap.—IAEI**—City and County Bldg., Denver, Col., August 13.

**Rocky Mt. Chap.—IAEI**—City and County Bldg., Denver, Col., September 10.

**Illuminating Engineering Society**—National Convention—Chateau Frontenac, Quebec, Canada, September 18-21.

**International Municipal Signal Association, Inc.**—Annual Meeting—Miami Colonial Hotel, Miami, Fla., October 14 to 17.

**Rocky Mt. Chap.—IAEI**—City and County Bldg., Denver, Col., October 8.

**National Electrical Manufacturers Association**—Annual Meeting—Marlboro-Blenheim and Claridge Hotels, Atlantic City, N. J., October 28 to November 2.

**All Industry Refrigeration Show**—Public Auditorium, Cleveland, Ohio, October 28-31.

**National Electrical Contractors Association**—Annual Meeting, Edgewater Beach, Miss., Oct. 28-31.

## MANUFACTURERS NEWS

### WESTINGHOUSE APPOINTMENTS

L. E. Osborne has been named senior operating vice president of the Westinghouse Electric Corporation, responsible to the president for all manufacturing units of the company. Mr. Osborne's new responsibilities also include all subsidiary manufacturing companies as well as the District Manufacturing and Repair Department and the Headquarters Manufacturing Division of Westinghouse. His office is transferred to Pittsburgh.

John K. Hodnette has been appointed manager of the Company's Transformer Division at Sharon, Pa. He has been



**J. K. HODNETTE**

engineering manager in that division for the past six years, and assumes the duties formerly held by H. V. Putman, vice president in charge of the Transformer Division, who died last January.

Ralph H. Sroufe has been transferred to Portland, Oregon, as manager of the

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### THE PYLE-NATIONAL COMPANY

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Westinghouse Electric Supply Company in that city. Mr. Sroufe has been manager of the Iowa Division of the Northwestern District, with headquarters in Des Moines, Iowa. Robert T. Rogers, recently a Major in the Army Air Corps, will succeed Mr. Sroufe at Des Moines.

### GRAYBAR NAMES D. R. EDGE RURAL LINES SALES MANAGER

The promotion of Donald R. Edge from assistant rural lines sales manager to the position of Rural Lines sales manager for the Graybar Electric Company has been announced. Mr. Edge will succeed Mr. K. B. Mayer who is retiring. He will make his headquarters in Chicago.

Mr. Edge has been intimately connected with REA activities since 1936, having managed the Union Rural Elec-



D. R. EDGE

tric Cooperative in Marysville, Ohio, which he left to organize and later manage the Central Electric Cooperative, Inc. at Parkers Landing, Pa. For the past three years Mr. Edge has cooperated with General Electric Company engineers in a series of field tests which have led to a number of refinements in transformers and line protective equipment.

### PLAINVILLE ELECTRICAL PRODUCTS CO. REORGANIZED

The Plainville Electrical Products Company of Plainville, Conn., has been reorganized. A new company of the same name was formed on February 1, 1946 to take over the facilities and business of the old company. C. R. Sherman, general manager of the old company has been elected president and C. H. Alvord has been elected vice president.

Before coming to The Plainville Electrical Products Company in 1926, Mr. Sherman was associated with the Trumbull Electric Mfg. Company.

Mr. Alvord, a Lieutenant Colonel in the A.A.F., was formerly general manager of the Hart Mfg. Company in Hartford. In 1941-42 he operated the Alvord Engineering & Sales Company of Hartford, Conn.

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In addition to excellent explanations of such developments as frequency modulation, network television, and the electron microscope, the book presents a clear-cut summary of the sensational advances in the field of atomic energy, including a survey of pioneer work in this field and a factual account of the atomic bomb, based on the authentic Smyth report. The significance of radar and loran for peacetime applications is also thoroughly discussed, and a full chapter is devoted to some of the newest knowledge about the effect of the sun and the moon on radio on the earth.

Seventeen fascinating chapters give you an easy-to-understand picture of the whole field of electronics:

- |                              |                            |
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| 4. Putting Them to Work      | 12. Looking Through Matter |
| 5. Talking Around the World  | 13. Smaller and Smaller    |
| 6. Seeing Beyond the Horizon | 14. Electrons in Medicine  |
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What are electrons, and where do they come from? How does television work? What is the secret of radar, of loran, of BTO? What is a diode? an ignitron? a klystron? a preclotron? How are pictures and facsimile newspapers transmitted over wires or through the ether? How is sound recorded on motion-picture film and on phonograph records? What is the outlook for postwar developments in electronics?

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Electrical Contracting, April 1946

## W. W. WATTS APPOINTED SALES MANAGER OF RCA

Appointment of W. W. Watts as general sales manager of the Engineering Products Department of RCA Victor Division has been announced. Mr. Watts



**W. W. WATTS**

comes to RCA after serving as a Colonel in the Signal Corps for three and one half years.

Mr. Watts, whose headquarters will be at Camden, N. J., will direct the merchandising, advertising and selling activities of the Engineering Products Department.

Prior to his association with the Army, Mr. Watts was connected with Montgomery Ward & Co. and the Zenith Radio Corporation.

## T. E. LIEBERT NAMED SALES MANAGER

Superior Carbon Products, Inc. of Cleveland, Ohio has announced the ap-



**T. E. LIEBERT**

pointment of Theodore E. Liebert as sales manager. He was formerly superintendent of production.

## MILLER COMPANY APPOINTMENTS

John J. Slevin has joined the Miller Company's Illuminating Division Field Engineers' Corps with headquarters in New York City. He comes to Miller

*Electrical Contracting, April 1946*

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## TIME SWITCH

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**Well Engineered**

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- The case can be mounted easier.
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Decrease Your Costs  
with**

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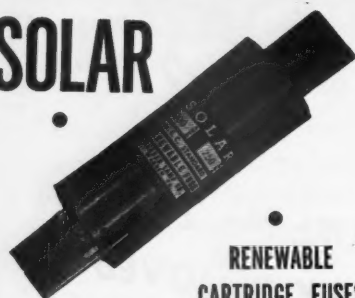


12 1/2 lb. can (6 to a carton)  
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Drum (about 500 lbs.)

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or order Direct.

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LINDEN, NEW JERSEY

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**RENEWABLE  
CARTRIDGE FUSES**

- **SHOCK-PROOF!**

Patented construction eliminating end ferrules on the larger sizes makes fuse pulling safe.

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Only two parts besides the link means quicker renewal and no parts to lose.

- **HIGH LAG!**

Scientifically designed links eliminate unnecessary blow-outs and save both time and money.

- **RUGGED CONSTRUCTION!**

By comparing the heavy cartridge wall with ordinary fuses, one realizes the added strength of Solar fuses.

Write Dept. F-346  
for further information and quotation

**SOLAR ELECTRIC CORPORATION**  
WARREN, PENNSYLVANIA

from Sperry Gyroscope, where he was employed as senior electrical methods engineer.

M. J. Rudman has joined the Illuminating Division as Field Engineer, and has taken over the lower Pennsylvania and Delaware territory.

### ALLIS-CHALMERS APPOINTMENTS

Joseph Bronaugh has been named manager of a newly established Miami branch office of the Allis-Chalmers Mfg. Co., Milwaukee, Wis. The office is located at 1404 Postal-Pacific Bldg., Miami, Fla.

R. F. Muller, sales engineer with the New Orleans district office has been promoted to assistant manager of the office.

### DESPATCH OVEN ELECTS OFFICERS

At a recent meeting of the stockholders of the Despatch Oven Company, A. E. Grapp was elected chairman of the Board of Directors. In 1913 Mr. Grapp was made president and treasurer, and in assuming this new office he still retains the office of treasurer. H. L. Grapp was elected president and general manager.

F. H. Faber was named executive vice president and general sales manager. He joined the organization in 1928 and has worked steadily up through the Engineering and Sales Engineering Departments.

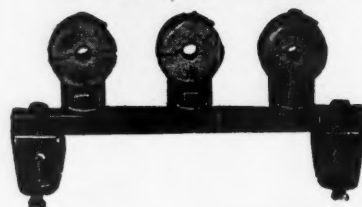
G. M. Lund was made vice president and secretary. Mr. Lund came with the company eight years ago as purchasing agent; was promoted to comptroller and later made secretary.

The Potter & Brumfield Sales Co. has been incorporated in the State of Illinois to handle all domestic and export sales of relays, process timers and electro mechanics manufactured by the Potter & Brumfield Mfg. Co., Inc., Princeton, Ind. An office has been opened at 549 West Washington Blvd., Chicago and operation of the Sales Company will be under the direction of Ralph T. Brengle, president.

The appointment of Clyde W. Foster as western sales manager of the Bryant Electric Company, Bridgeport, Conn., has been announced. Mr. Foster has been with the company since 1919 and has been assistant manager of the Western Sales Office since April 1944. He succeeds William A. Stacey, who retired after 37 years with the Bryant organization.

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Racks available for any number of cables — cable sizes 5/16" to 2 3/4".

Available in types for any number of cables, the M & W Type S-L Conductor Rack is designed so that cables are only partially surrounded by metal. This prevents induced current—permits the rack to be used for A.C. or D.C. systems. Simple design makes for quick, easy mounting of cables.

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The only pocket-size tester with **PATENTED SAFETY FEATURE**. Lifetime guarantee. List \$1.50. Purchase thru regular electrical dealers. Pat. No. 1,778,883



**For Quick Soldering**

A small quantity applied to the joints to be soldered will, WHEN HEATED, flow and unite the parts the same as wire and bar solder. No flux or soldering iron required. 25c tubes; 1, 5, 10 and 25-lb. cans.

**L. S. BRACH Mfg. Corp.**

200 Central Ave., Newark, N. J.

Ward Leonard Electric Co., Mount Vernon, N. Y. has opened a new branch office in the Industrial Office Building, Newark, N. J. R. W. Vonasch, formerly with the Sales Engineering Department, is district manager.

General Cable Corporation has announced the appointment of Allen D. Pettee as chief electrical engineer of the corporation.

Cornell-Dubilier Electric Corporation has leased a new plant at 55 Cromwell Street, Providence, R. I. This new manufacturing space, comprising 26,000 square feet, will be used as a feeder, producing sub-assemblies for the company's other factories.

S. V. Dillon has been named staff manager, Electrical Section, Johns-Manville Sales Corporation. Mr. Dillon has been associated with Johns-Manville since 1920, serving as an electrical specialist in the Sales Engineering Department and as assistant manager, Public Utility and Electrical Department until his present promotion.

Robert B. Davison has joined Ellinwood Industries of Los Angeles, as Western Division sales manager of the Farm Equipment Division.

D. Paul Ayers, formerly division engineer of the Kansas Power & Light Company at Topeka, Kansas, has joined the sales engineering staff of Copperweld Steel Company, Glassport, Pa.

The Electric Products Company, Cleveland, Ohio, announces the addition of Robert H. Ehret to the Headquarters Sales Staff. Mr. Ehret will be responsible for handling headquarters sales negotiations.

Earl G. Koehler has been appointed sales manager of the Lighting Division, The Federal Glass Company, Columbus, Ohio. He was formerly in the Sales Department of Macbeth Evans Division Corning Glass Works.

W. S. Colson, 6942 Dartmouth Ave., St. Louis, Mo. has been appointed sales representative by Gibson Electric Company, Pittsburgh, Pa. His territory includes Missouri, Kansas, Arkansas, and Oklahoma.

*Electrical Contracting, April 1946*



The illustration shows a hand holding a sign that reads "SIGN LIGHTING TAILORED TO FIT". Below the sign is a Goodrich sign reflector, which is a hexagonal-shaped device with a central lens and the word "GOODRICH" on its top. The reflector is shown in a perspective view, highlighting its three-dimensional design.

**the  
KEYSTONE  
SIGN REFLECTOR**

Yes, there is a big difference in the way signs are illuminated. And it doesn't cost a penny more to do it correctly—with light that's tailored to fit.

That's the way the Keystone Reflector illuminates square or rectangular signs. It spreads the light uniformly on the face of the sign—uses the lamp's full intensity. It cuts the light off so there's no waste at top, bottom or sides. That's what gives these signs their readability, their well-tailored look.

The Keystone Sign Reflector, an exclusive Goodrich design, is finished in permanent porcelain enamel, weatherproof. It's one of a series of Goodrich sign reflectors for illuminating square, rectangular, oval or round shapes—each in the most efficient way. Equipped with the Goodrich Seprable Hood, they are easy to install, easy to service and include a resilient socket which eliminates vibration, assuring maximum lamp life. Write for literature.

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In Automatically  
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LIGHTING SYSTEMS**

And Dozens of Other Applications  
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**2200-Watt AUTOMATIC  
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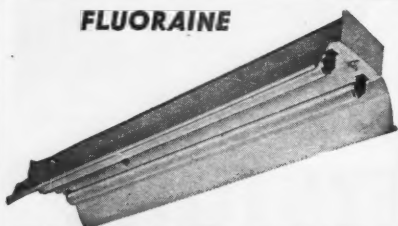
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**Electric Manufacturing Co.**  
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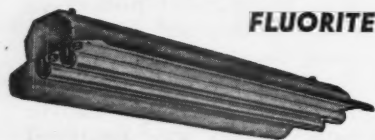
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**ELECTRICAL MANUFACTURING CO.**  
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**IMPACT OF WAGE-PRICE  
POLICY**

[FROM PAGE 77]

reduced overtime and down-grading. "Fact-Finding" boards have established a precedent by decisions in other industries that might encourage demands for a rise of as much as 18 percent in average straight time hourly wage rates for electrical manufacturers.

*The experience of 87 Companies*

Of 87 companies, 46 have not increased wage rates since V-J Day. In January 1941, average straight-time hourly earnings of labor in these companies varied widely (the range was from \$.40 to \$1.08). Since then wage rates have increased anywhere from \$.05 to \$.43 an hour, with those companies having the higher initial rates generally granting the larger increases. If each of these 46 companies were to pile a further 18 percent on top of past advances, the total increase since January 1941 for most of them would range from \$.35 to \$.60 an hour. This amounts to better than a 75 percent advance for more than half the companies.

The other 41 companies report labor's straight-time hourly rates are 2 to 18 cents an hour more today than at V-J Day. Most advances are on the small side and with but three exceptions a further increase is necessary if a final rise of 18 percent over V-J Day is to be granted.

*Costs and Prices*

The tremendous upsurge of costs contrasts markedly with the more modest rise in prices required if these companies are to realize even the limited profit minimum set by OPA.

Prices for 51 companies still rest where they were in January 1941. Raw material prices have already been increased 10 to 25 percent for most of them and promise to rise another 10 to 20 percent, while labor costs stand to be jacked up 50 to 90 percent above January 1941. Nevertheless, two-thirds of the producers believe a price increase of 5 to 20 percent is all present OPA regulations will permit them.

A similar story is apparent from the record of 36 producers who already have been granted price increases of 5 to 12 percent for certain products. This is to be expected, inasmuch as OPA would hardly have permitted an initial price rise to cover cost advances that were not even anticipated at the time.

*Small Companies show Largest Per-  
centage Wage Increase*

The 87 companies were divided into

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**Start now to earn  
the bigger pay in  
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Was there ever such an opportunity to get started in electrical maintenance and repair—and at top-notch wages? Are you ready—with experience and ability—to cash in on it? Others are getting just the sort of background needed—quick! practical!—to handle the great variety of electrical maintenance and repair work TODAY—from this well-known electrical library. You can too!

**Electrical Maintenance  
and Repair Library**

5 volumes, 2042 pages, 1721 illustrations

Gives you the "know-how" to tackle any wiring or motor job. Five books show you HOW—to install all types of motor and generator units—to inspect and repair motor starters and generators—to diagnose motor and generator troubles—to figure new windings for old cores, DC and AC windings—to test armature windings, test induction motors, etc., etc. The new book is full of trouble-shooting charts that show quickly symptoms, causes, specific remedies, etc.

*Includes trouble-shooting book*

Now in addition to four well-known practical books on all details of testing, connecting, rewinding, installing and maintaining electrical machinery, the Library includes Stafford's *Troubles of Electrical Equipment*, a handy book giving helpful maintenance information, special trouble-shooting charts, explanations of symptoms and causes of machinery troubles, specific remedies, etc. This revised library gives you the ability to handle bigger jobs with surety of results.

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We want you to examine this Library for 10 days. If you don't want them at the end of that time, there's no obligation to keep them. On the other hand if you decide you want the help these books can give, start the small monthly payments then, and in a short time the books are yours, right while you have been using them. Send the coupon today.

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three size groups: 23 large (more than 2500 employees); 23 medium size (500 to 2500 employees); and 41 small (500 or less employees). Of the 29 companies (upper one-third of the group) reporting the largest percentage wage increase since January 1941, only two were of the "large" category; while 18 were small and nine medium sized. Almost half the large companies were among the third of the total reporting the lowest percentage increase in wages.

This difference in percentage wage advances of large and small companies is chiefly the result of two factors: large companies generally had higher wage levels in January 1941, and wage increases in terms of cents per hour since January 1941 have been fairly equal for all companies, irrespective of size or initial wage rates.

#### *The Rise in Raw Material Costs*

Increased wage rates in the metal producing industries are the principal cause of higher raw material costs. For example, more than a ton of steel was used in the manufacture of \$1,000 (at sales price) of electrical appliances or \$1,000 of generating equipment in the pre-war period. Copper is another important material: in pre-war days 175 pounds were consumed in the manufacture of \$1,000 of electrical appliances and 300 pounds in the production of \$1,000 of generating equipment. Steel and copper both embody large amounts of labor, much more than power, lumber or coal. As heavy metal consumers, therefore, the new wage-price policy catches electrical



**Jacob Ross (right), General Electrical Shop, Ann Arbor, Mich., and E. L. Santschi, Chicago, NECA Division 4 field representative are confident of the success of the newly organized Michigan electrical contractor group.**



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The architectural beauty, high quality, and performance keyed to modern living, of Auth apartment telephones, signals and mail boxes have led to selection of Auth for hundreds of modern apartment developments.

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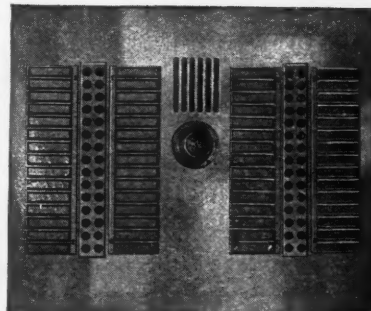


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Expert design, choice materials and controlled manufacture have built "top-service and longest life" into Minerallac Electrical Specialties. That's why the electrical industry "prefers Minerallac"... In steel and Everdur for hanging pipe, conduit, BX cable, etc.

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**FACTS**  
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- 100% conductivity

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**ILSCO** COPPER TUBE & PRODUCTS, Inc.  
CINCINNATI, OHIO

goods producers indirectly as well as directly.

One company of more than 2500 employees producing a number of electrical products reported the following change in cost of various materials from January 1941 to January 1946.

	% Increase
Steel Castings .....	11
Coal .....	16
Pig Iron .....	45
Mica splittings .....	56
Lumber .....	23
Stainless steel for Turbine Blading .....	1.16
C. S. Plate H. R. ....	7.14
C. S. Sheets H. R. ....	4.76
C. S. Bars H. R. ....	4.65

	% Increase
Electrical sheet steel	
Armature .....	2.82
Elect. ....	2.47
Transf. No. 52 .....	1.18
Transf. No. 72. ....	1.40
Cold Rolled Steel Bars	
Alloy Steel	
Bars SAE 3100 .....	4.41
Pig Iron	
Hi Phas .....	4.18
Silver .....	29.09

All electrical goods manufacturers have been hit by increased labor and raw material costs. However, producers specializing in the manufacture of motors and generators, as well as those concentrating on transmission and distribution equipment, appear to have had the heaviest percentage increases in labor costs. However, the advance in raw material prices has affected these companies about the same as it has others. In part their larger wage increase results from the fact that a number of companies with less than 500 employees are engaged in turning out these products and wage rates of these companies in January 1941 were below the average for all electrical manufacturers. As a result these producers on the average report they require a somewhat greater advance in prices than the manufacturers of other electrical goods.

Electrical appliance firms show a heavier labor cost increase than many others. The average wage-rate in these companies was above that for the industry as a whole in January 1941; and with this big base, a further 18 percent increase would be large relative to others. On the other hand, price ceilings already have been raised on some appliances; and although these companies believe they require additional price relief, the price advance they report as necessary is smaller than that of those firms that specialize on other products.

## TEST INSULATION THE MODERN WAY



... WITH A  
MODEL B-5

## MEGOHMER NEW BATTERY-VIBRATOR TYPE

No more tiresome cranking of a hand-driven generator. Entirely self-contained. Steady test potential of 500 volts D.C. available at the touch of a switch. Direct reading in insulation resistance. Various new models and ranges.

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Available in a wide variety of sizes, shapes, candle power and voltages—standard and candelabra bases.

A large supply of all standard types are carried in stock, thus assuring you prompt service at all times. Write for catalog sheet 1-2 for full details or see your Electrical Wholesaler.



**NORTH AMERICAN  
ELECTRIC LAMP CO.**

1044 Tyler Street, St. Louis 6, Missouri

## GROUNDING INDUSTRIAL POWER SYSTEMS [FROM PAGE 80]

expect the ground fault current in the primary of the current transformer to appear in the residual secondary connections of the current transformers to the residual relay, in proportion to the nominal ratio of the current transformers. Practically, however, it is necessary to consider the relay burden and exciting current of the current transformers to check the sensitivity accurately. This is especially true where bushing current transformers of low current rating are used.

In the case of ground relaying, all of the current transformers connected to the ground relay are, in effect, in parallel, and thus the exciting current will be multiplied by the number of transformers across the ground relay.

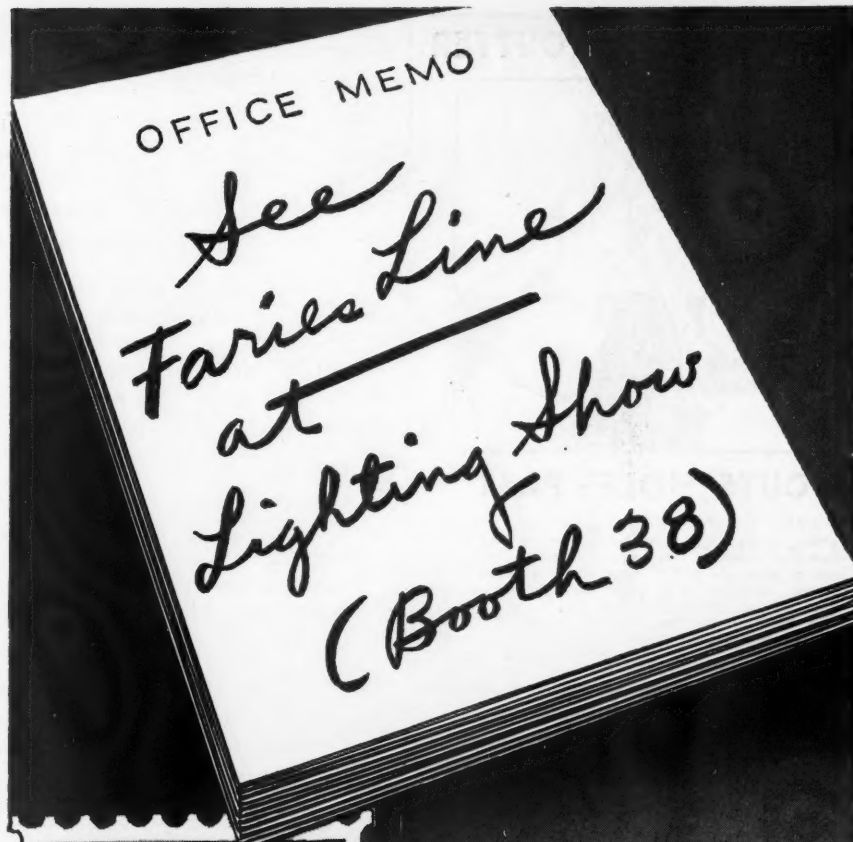
When a line-to-ground fault occurs, the primary current in the faulted phase must be adequate to pick up the residual relay and also to excite all current transformers at the voltage level required by the secondary burden. This frequently results in substantially more primary current being required than is indicated by the turn ratio calculation. For this reason it is desirable to check the minimum operating current requirement.

### Setting Relays

It should also be remembered that high impedance type faults may occur and also that faults may occur deep in transformer or generator windings in such a manner that the magnitude of the fault current will be substantially less than is the case for terminal faults or line faults. It is usually desirable to set the relays in such a manner that they will pick up on approximately 10 percent of the ground fault current which would be obtained from a terminal fault in the apparatus, in order that the relay protection reaches deep into the winding and thereby protect the major portion of the winding.

The desire to make the ground relays very sensitive must not be carried too far, because small differences in the current transformers and their saturation characteristics may give rise to fictitious currents, or error signals which may cause nuisance tripouts of the pickup levels if the relays are set too low. These error signals may be caused by transients, such as transformer magnetizing inrush currents, large through fault currents, or unbalanced line and cable charging currents, etc.

It is usually considered best practice to ground circuits at the source in order that as long as any circuit is energized it will be grounded. Where



You'll surely want to visit the Faries exhibit at the International Lighting Exposition. There you will see the newest and most modern designs in fluorescent and incandescent lamps and fixtures . . . for office and industry . . . and for the institutional market, too.

The Faries 1946 Line is the crowning achievement of 66 years of leadership in this industry. See it, and we know you'll be favorably impressed.

**Mr. J. V. Everard, Ass't Gen. Sales Manager, and other members of the Faries Sales staff will be most pleased to welcome you at Booth 38.**

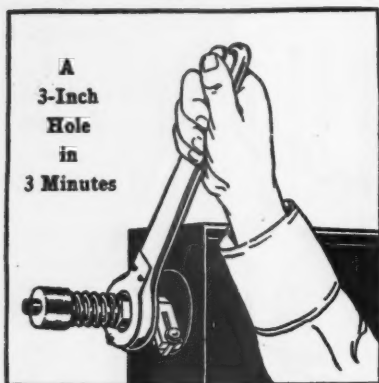


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"JIFFY" CUTTER makes quick easy work of cutting operation. Cuts holes from  $\frac{1}{4}$ " to 6" in diameter through any gauge sheet metal, cast iron or steel up to  $\frac{3}{4}$ " thick. Will also cut slate, marble, bakelite and other fiber materials. A timesaver on switch-box jobs that usually require extra holes where there are no knock-outs. Compact, light weight. Useful in switchboard building, industrial plants, sheet metal shops. Ratchet wrench and spring pressure permits easy operation in corners, on ceilings or in any cramped position.

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circuits are switched, it is essential that the ground current on any energized section be adequate under the minimum current condition.

To summarize briefly, the most important reasons for grounding circuits are to:

1. Minimize transient overvoltages, which may otherwise appear on the system.
2. Provide ready means for locating and isolating circuits which are faulted to ground.
3. Limit electrical displacement of neutral as required by any connected apparatus.

The reasons for limiting ground fault currents are to:

1. Reduce burning at the point of fault, and thereby minimize damage to machines or circuits.
  2. Reduce hazard to personnel and structures from stray ground fault currents.
  3. Minimize voltages which can appear in the ground fault current path.
  4. Reduce mechanical stresses in circuits and apparatus to acceptable values.
- Ground current must be adequate to:
1. Reduce possible transient overvoltages to a satisfactory level.
  2. Provide satisfactory relaying of ground faults.
  3. Limit electrical displacement of neutral as required by any connected apparatus.

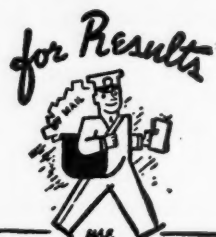


Public Buildings Administration officials, Washington, D. C., attending the IES East Central Regional Conference, Philadelphia, Pa. on January 31—February 1 were (l. to r.) Thomas F. Coghlan, Chairman, Capital Section, IES; Gilbert Stanley Underwood, Supervising Architect; and John N. Payne, electrical engineer.

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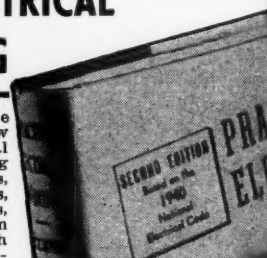


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## WHAT IS THE MARKUP?

[FROM PAGE 76]

data has to be published according to reports received. As a result, divisions of costs cannot always be established in the way which would best serve our purpose. Any survey data requires careful study and analysis, no matter how carefully prepared.

### What Determines Overhead

In order for an electrical contractor to appreciate the significance of data on overhead, he should be open-minded, and study it assiduously. In studying such information there are a few things which most contractors should keep in mind.

1. Few contractors realize how much it costs them to operate their business.
2. Any true cost will, on the surface, appear to be much too high.
3. Operating costs increase in proportion to the services rendered.

To conclusively prove the first statement, we have only to cite one known fact. The amount of money taken out of the business, as *real profit* is far below the percentages added for so called "profit." This is true even though the base material and labor costs come out as estimated. There is only one answer to explain the disappearance of this estimated profit. It was used up as operating costs.

*Profit* is money taken out of the business, and set aside as a permanent gain.

It is amusing and sometimes exasperating to observe how many contractors delude themselves about the profit they are making. One of the favorite ways is to have a small drawing account in lieu of a salary and call what is left at the end of the year "profit." Another is to consistently underestimate operating costs.

The errors in estimating operating costs run as high as eight to nine percent. These errors are made in the "front office" by men who are supposed to be the "brains" of the organization. If the estimator, preparing the base cost of material and labor, made any such mistakes, he would be "fired." Is it any wonder that high grade estimators with business ability, hesitate to go into the contracting business? They know what their competition would be.

It is only natural, as outlined in the second statement, that any true figures on operating costs seem much too high. We are in the habit of thinking in terms of known costs of an individual job, and such costs are usually for the larger projects. If we considered all jobs, large



MULTIPLY YOUR  
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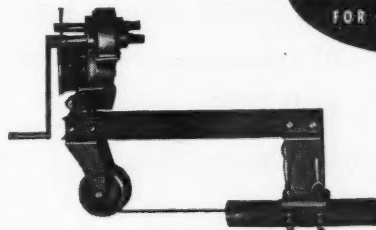
"With our GREENLEE Hydraulic Pipe Bender a three-hour hand job on conduit (even using fittings instead of bends) is reduced to 20 minutes," says E. W. Willis, Vice President, Clark & Mills Electric Co., Boston.

When you can set up the GREENLEE Bender, make four accurate, smooth bends for a "saddle" as shown above, in a third of an hour . . . and save the cost of four fittings . . . you make tremendous savings.

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Gage of the above firm reports, "Never spoiled a pipe in three year's use of the GREENLEE and we wasted plenty by getting kinks before."

Enjoy the extra time and material savings provided by the GREENLEE Bender . . . *one-man operated* for bending pipe up to 4 1/2", rigid and *thin-wall* conduit, tubing, bus-bars. Rugged, compact, portable . . . easy to transport, set up and operate. Write for complete information today. Greenlee Tool Co., Division of Greenlee Bros. & Co., 1744 Columbia Avenue, Rockford, Illinois, U. S. A.



### GREENLEE CABLE PULLER

Simple, compact unit exerts 7500 lbs. maximum pull, has two speeds through direct and back gears. Fastens direct to conduit — allows pulling in line with conduit, prevents hanger loosening. Flexible elbow attachment for pulling from concealed conduit.

### OTHER GREENLEE TIMESAVING TOOLS FOR ELECTRICAL WORK

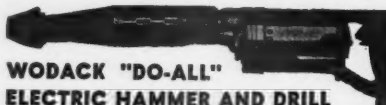
Hand Benders • Joist Borers • Radio Chassis Punches • Knockout Tools • Pipe Pushers



# WHERE TO BUY

Equipment, Materials and Supplies for  
Electrical Construction — Maintenance — Repairs

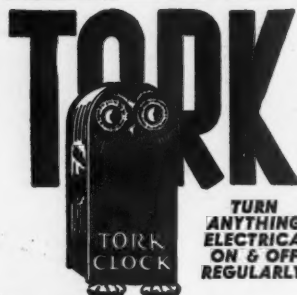
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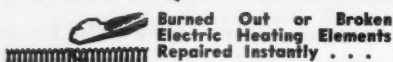
The TORK CLOCK CO., Inc.  
MOUNT VERNON, NEW YORK



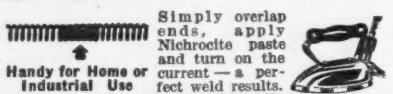
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**A Pusher . . . A Puller  
A Reel . . . A Fish Tape**  
The fish tape is pushed, pulled, wound and unwound by simply pumping the handle. One man can pull as much as three with the Kuehl Fish Tape Gun. It offers a 3 to 1 mechanical advantage. Write for descriptive bulletin.  
**D. S. KUEHL & SON**  
Clio Michigan

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## This WHERE TO BUY Section

supplements other advertising in this issue with these additional announcements of products and services essential to efficient and economical operation, maintenance and service. Make a habit of checking this page, each issue.

Departmental Staff

**ELECTRICAL  
CONTRACTING**

and small, the costs would be higher. Again, in any such mental calculations, the cost of adjustment time between jobs, expense of maintaining the business during slump periods, vacation salaries, and incidental expenses, are overlooked.

Electrical contracting costs are not easily established. Those thoroughly familiar with them have to do a great deal of checking before they can reconcile substantial findings. It is not enough to check one job, or one year's business to establish overhead costs. *Business operations have to be checked over a period of years.*

The third statement is borne out by the fact that the better the engineering and overall supervision supplied, the higher the direct job costs and general overhead expense. Hand in hand with the better service should go a better job and a better price.

*Example:* Consider a \$10,000 (base cost) job with a "60-40" ratio (60% material cost and 40 percent labor cost). With mediocre engineering, tools and supervision, we shall say that the markup would be 20 percent. This 20 percent would represent approximately 10 percent on material and 35 percent on labor. With 5 percent added to material and 10 percent to labor for a return, the estimate of the selling price would be as follows:

	Material		Labor
Base Costs .....	\$6,000		\$4,000
Markup for job costs and OH 10%.....	600	35%	1,400
Estimated job costs..	6,600		5,400
Return 5% .....	330	10%	540
<b>TOTALS .....</b>	<b>\$6,930</b>		<b>\$5,940</b>
Total estimated sell price = \$12,870 — (6,930 + 5,940)			

Take the same job and say, by better engineering, tools and supervision, the cost of labor could be reduced 10 percent. The cost of labor would then be \$3,600. (4,000—10%). The cost of engineering, tools etc., would be increased. In the first case the markup on labor amounted to \$1,400. Let us add 10 percent to this for the second job and we shall have \$1,540. This is 43 percent of the revised labor of \$3,600. The revised estimate would be:

	Material		Labor
Base Costs .....	\$6,000		\$3,600
Markup for job costs and OH 10%.....	600	43%	1,540
Estimated job costs..	6,600		5,140
Return 5% .....	300	10%	514

**TOTALS .....** \$6,930 \$5,654  
Estimated sell price (6,930 + 5,654) = \$12,584.  
Percentage of job markup for operating costs—

$$= \frac{600 + 1540}{6000 + 3600} = \frac{2140}{9600} = 0.222 = 22.2 \text{ percent}$$

Electrical Contracting, April 1946

In the first instance the markup was 20 percent as against 22.2 percent in the second. This additional 2.2 percent markup enables the buyer to get a better job in a shorter time and with a saving of \$276. or 2.3 percent.

These are fabricated figures, but in practice such results really occur. Contractors realize this; that is why the better ones are willing to pay good salaries to get competent engineers. The performance of any good organization will demonstrate what Mr. McChesney meant when he said, "High overhead is nothing to be ashamed of."

We use the term "high" reservedly in connection with electrical contracting. The only time operating costs are high is when they are out of proportion to services rendered.

If we are going to justify our existence as electrical contractors, we must be able to handle the job better than any one else. As Donald B. Clayton so aptly expressed it at the 1943 NECA convention in Chicago, "There is nothing worth having that some other group does not want, including what we have come to think of as belonging to us. It belongs to us only if we can show that we deserve it."

That is a long story condensed in two sentences. Customers may haggle about prices, but in the final analysis they appreciate quality. Our most successful contractors have reached the position they occupy today by the step by step method. Each job was a quality job which served as a step toward better jobs and better prices in the future.

We hear much about "Competent Contractors." If asked to give my definition of a Competent Contractor, the wording would be something like this: "A Competent electrical contractor is one who has an organization together with tools and equipment, which will enable him to expeditiously prosecute any work undertaken." An owner, by employing such a contractor, should be able to get a better job delivered in a shorter time, and at a better price (quality of services considered) than he could get by any other method.

#### Overhead Will Vary

Overhead is not some fixed percentage that can be used indiscriminately for all jobs as they come. Like other operating costs, it has to be estimated in accordance with the merits of the individual job. Many things have to be considered when making such estimates. Size of project, nature of work, duration, and working conditions all have to be taken into account. As job costs increase so also must overhead, because many of the unidentified costs are in



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R&S reflector contours are scientifically designed with high reflection factor providing a maximum of safe controlled light at minimum cost.

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R&S explosion-proof lighting fixtures are supplied with a standardized base common to all sizes. Reflector globe assemblies of various capacities are interchangeable to suit conditions. No need to disturb mounting or electrical connections. Modern design simplifies mounting and affords a variety of conduit arrangements in one standard base. Installation costs are lower, parts fewer and ordering easier.

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EXPLOSION-PROOF, WATER-TIGHT, INDUSTRIAL LIGHTING FIXTURES  
AND EQUIPMENT, AUTOMATIC LOCKING "EVER-LOK" CONNECTORS

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NEW ADVERTISEMENTS received by 10 A.M., March 22nd, will appear in the issue of April, subject to limitation of space available.

## POSITION VACANT

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MANUFACTURERS—ATTENTION. A man of 25 years electrical construction experience as a contractor, estimator, superintendent, and journeyman electrician, with an ideal contact in the architectural, engineering, construction and jobbing field, wishes to represent one or two manufacturers of repute in Minnesota and the adjoining states. RA-361, Electrical Contracting, 520 N. Michigan Ave., Chicago 11, Ill.

## REPRESENTATIVE WANTED

Established representatives wanted by insulated wire manufacturer. Experience and following in the wholesaler and major industrial fields essential. Advise exact territory being covered.

RW-364, Electrical Contracting  
330 West 42nd St., New York 18, N. Y.

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### NEW 3 H. P. MOTORS

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(19 mi. West of Atlantic City, N. J.)

TUESDAY, APRIL 30, 1946

At 10 A. M. on the premises

LAND: An Indst'l Site; also Extensive Acreage, Road Frontage on Harding Hwy—Mays Landing—Malaga Road.

100 WOOD FRAME WEATHER BOARD BLDGS., STEEL ROOFS & SIDES; 3 ERIE CITY 85 & 125 HP HORIZ. TUBULAR BOILERS, 2 FEED PUMPS, CURTISS TWO STAGE M.D. AIR COMPRESSOR, TOLEDO SCALE Cap. 1600 lbs.; 50 G. E. TRNSFMRS 1 1/2 to 150 KVA; Apx. 28,800 ft. Lt. & Pwr. Wire, Floodlights, Street Lights, Vapor & Explsn. Proof Fixtures, 184 Chstnt Poles, 35 to 45 Ft. Elec. Wire, Apx. 20,000 Ft. Steam & Water Piping 3/4 to 6 in.; 9 Cypress Water Tanks 30,000 & 50,000 gal; Apx. 12,000 ft. 70 & 90 lb. Std. RR Rail, Apx. 16,000 Ft. CYCLONE FENCING; Porcelain Tankless Hoppers, Wash Basins, Steam Radiators & Manifolds, Water Heaters, Supplies, Trucks, Office Furniture, etc.

### AT SINGERLY, MARYLAND

(2 mi. west of Elkton on Elkton-Singerly Road)

THURSDAY, MAY 2, 1946

At 10 A. M. on the premises

LAND: Manufacturing Site & Apx. 100 Acres of Farm Land, Excellent Road Frontage.

100 BLDGS., WOOD FRAME, STEEL ROOF SIDING, TRUSCON FABRICATED BLDG. 40' x 50', Concrete Block Hollow Tile Bldgs., Hodges 286 HP 125 lb. Boilers, 2 E. C. Boilers, 55,000 gal. Steel Tank, 11,000 FT. CYCLONE FENCING, 20,000 FT. ELEC. WIRE & CABLE, 200 Chstnt Telegraph Poles, 3 Wstnghs 150 KVA Trnsfmrs, 300 VAPOR & EXPLSN PROOF LIGHTS, SPOT & FLOODLIGHTS, PORCELAIN TOILET HOPPERS, BASINS & URINALS, TERRAZA CIRCULAR WASHING FOUNTAINS, Fluorescent Lights, 10,000 FT. STEAM & WATER PIPING, SUPPLIES & OFFICE FURNITURE, HARDWARE, ETC.

### AT CORDOVA, TENNESSEE

(17 mi. east of Memphis)

(Plant is 1 mi. east of the town of Cordova)

TUESDAY, MAY 14, 1946

At 10 A. M. on the premises

LAND: Industrial Site of approx. 261 Acres. 165 FRAME BLDGS., WOOD FRAME, CONCRETE OR WOOD FLOORS, SHEET METAL WALLS, FELT ROOFING, SASH & DOORS, INSULATION BOARD & PLYWOOD. Equipped with Elec., Six 50,000 gal & four 30,000 gal WOOD TANKS, BOILERS & PUMPS, Total of 470 HP, Two 125 HP, three 60 HP, one 40 HP HORIZ. ERIE CITY 125 LB. FIRE PROTECTION & FEED PUMPS; Lt. & Pwr. Trnsfmrs from 1 1/2 to 150 KVA, Apx. 30,000 Ft. Lt. & Pwr Wire, Flood, Street, Vapor & Explsn Proof Lights, Apx. 25,000 Ft. Steam & Water Pipe, 1/2" to 6", Toilets, Washbowls, etc.; Apx. 15,000 Ft. Std. RR Rail, Locomotive, Apx. 18,000 Ft. Cyclone Fencing.

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Descriptive and illustrated Catalogue upon application to Auctioneers

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## SAMUEL T. FREEMAN & CO., AUCTIONEERS

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1808-10 CHESTNUT STREET, PHILADELPHIA 3

80 Federal Street, Boston 10

proportion to direct job costs. Figure 2 portrays some of the innumerable things that determine legitimate overhead.

The contractor who persists in using a common markup for all jobs, (all other things being equal) will end up by getting the less desirable jobs, and his competitors will get the more desirable ones. Cases are common where contractors have lost some of their best customers because they insisted on applying an overhead which was out of proportion to the work contemplated. For select jobs they tried to sell an overhead established for all classes of work—good, bad and indifferent.

The estimating units appearing in the previous articles ("How Much Will It Cost?") were for a select class of work. (In checking the markup used in the previous articles, the reader should remember that some of the major direct job costs such as supervision, inspection, etc., were included with the material and labor costs). Industrial work, including all material, has always been considered as among the best risks. Contractors are familiar with all the reasons for this.

#### Material Vs. Labor Overhead

So far, the discussion has been more or less general. One very important phase of estimating overhead has not been covered—the importance of estimating all costs for material and labor separately. If we are to operate an electrical contracting business on a sound basis, labor must be divorced from material for estimating purposes.

This subject will be discussed in a subsequent article in *Electrical Contracting* under the title "Material Overhead Versus Labor Overhead." At the same time details on estimating overhead will be discussed more fully.



Chicagoans S. R. Todd (left), city electrical inspector and A. J. McGivern, managing director, Chicago Electrical Wholesalers Association, engage in an after-session confab at recent Illinois Chapter, IAEI meeting.

## \*COLOVOLT COLD CATHODE INDUSTRIAL FIXTURES



Here is the new Colovolt industrial fixture, one of a complete line of industrial and commercial "packaged" units. Equipped with the standard 93" Colovolt 10,000 hour lamp, Colovolt fixtures may be used singly or in continuous line lighting in multiples of 8 feet. Instantaneous starting, no flickering, guaranteed for 1 year ex-

cept for failure due to breakage are extra advantages of the Colovolt Cold Cathode low voltage fluorescent lamp. The long life expectancy of Colovolt lamps may be realized even when constantly turned on and off, and pre-scheduled re-lamping, with no loss of production or time, is now possible with Colovolt installations.



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Contact your electrical wholesaler or jobber, or write us for full details and prices.

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**CUT Any SIZE\* HOLE  
TO Any  
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Something new in wood-boring tools! Bruno Expansive Bit works like a lathe... requires less pressure... actually pulls itself through. Positive lock with patented triangle blade. Diamond grind on lead screw prevents splitting. Wide throat for chip clearance. Easy-to-read scale. All cutting surfaces of high grade tool steel. Replaceable blades.

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No. 200-B cuts ¼" to 1¼" Diameter . . . \$2.95  
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Each comes with 1 long, 1 short cutter.

Ask your jobber,  
or write  
**Bruno Tools,  
Beverly Hills,  
California,  
Dept. EC-4**



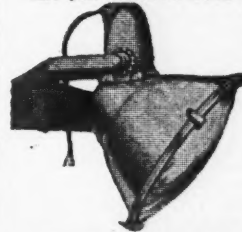
**BRUNO TOOLS**

Beverly Hills, California

**You Gotta HAND  
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YES, and because Revere equipment is EASY to wire, EASY to maintain you can DEFINITELY assure your customers MORE working footcandles!



4200 Series Enclosed Type Flood for sports and other wide area lighting. Rotates in yoke for EASY, safe maintenance



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★ These companies have supplied additional buying information on their products in the 1946 edition of the Electrical Buyers' Reference

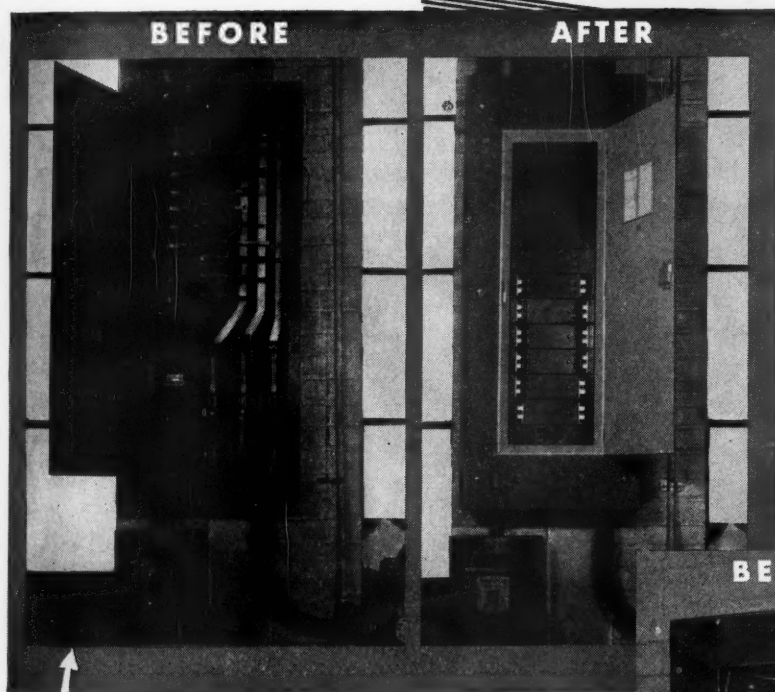
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# CONVERSION

# PLAN

THAT REALLY PAYS OUT

• Here are two typical examples of conversions which involved a minimum of installation time and labor and brought the following results:



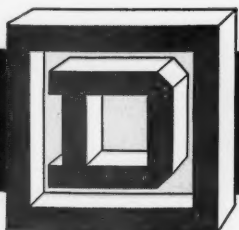
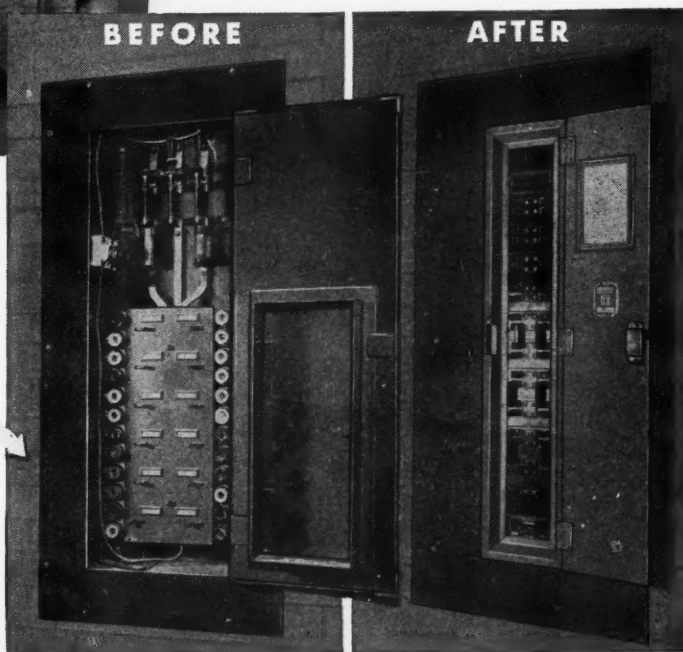
## 300% MORE CAPACITY...

From three to twelve 3-pole circuits and provision for eight more whenever needed. Existing box was used and no conduits added.

## 138½% MORE CAPACITY...

From 13 to 31 single and two-pole circuits. In addition, a needed 3-wire circuit was provided at bottom of panel. A speedy and economical changeover.

1. Increased panelboard capacities and added modern circuit breaker convenience and protection.
2. Utilized existing boxes and conduit.
3. Conserved power previously lost through overloads.
4. Eliminated the replacement of branch circuit switches and fuse clips due to excessive heating.



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MILWAUKEE

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